



June 2003

Hill Air Force Base

**Cultural Resources Inventory of the South Route to Wild Isle and TS-5,
Utah Test and Training Range, Tooele County, Utah**

**United States Air Force
Air Combat Command**

20031015 029

Global Power for America

REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.				
1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE June 2003		3. REPORT TYPE AND DATES COVERED Final August 2001-June 2003
4. TITLE AND SUBTITLE Cultural Resources Inventory of the South Route to Wild Isle and TS-5, Utah Test and Training Range, Tooele County, Utah			5. FUNDING NUMBERS Contract No. DACA63-99-D-0010 Delivery Order No. 0024	
6. AUTHOR(S) Daron Duke				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Geo-Marine, Inc. 2255-A Renaissance Drive Las Vegas, Nevada 89119			8. PERFORMING ORGANIZATION REPORT NUMBER Geo-Marine, Inc. U.S. Air Force Air Combat Command Series Reports of Investigations Number 17	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army Corps of Engineers, Fort Worth District PO Box 17300 Fort Worth, Texas 76102-0300			10. SPONSORING/MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES				
12a. DISTRIBUTION AVAILABILITY STATEMENT Approved for public release			12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) The U.S. Army Corps of Engineers, Fort Worth District, contracted with Geo-Marine, Inc. to conduct archaeological inventory for a U.S. Air Force Air Combat Command (ACC) project on the South Air Force Range of the Utah Test and Training Range (UTTR), which is under the jurisdiction of Hill Air Force Base and located in Tooele County, western Utah. Pedestrian survey of an 18.4-mile access road, named the "South Route," to the TS-5 target complex on the Wild Isle dune field was performed in August 2001. The inventory resulted in nine newly discovered prehistoric archaeological sites. These are all flaked stone scatters resulting from activities that took place over 9,000 years ago by people of the "Paleoarchaic" era. During the Paleoarchaic, an ancient river named the "Old River" flowed into Late Pleistocene/Early Holocene Lake Bonneville (now diminished to the Great Salt Lake) from the Sevier Basin to the south. The lake margin was located in the vicinity of the South Route project area where a vast wetland associated with the deltaic drainage systems of the Old River or its remnants met the lake margin. Humans exploited this productive area intensively. When the lake receded and these waters stopped flowing, the area was abandoned. No sites eligible for inclusion on the NRHP were found, but together, the cultural deposits observed on the South Route inventory provide useful information on early lifeways in the Bonneville Basin.				
Name of Federal Technical Responsible Individual: Dr. Jay R. Newman Organization: U.S. Army Corps of Engineers, Fort Worth District, CESWF-EV-EC Phone #: (817) 886-1721				
14. SUBJECT TERMS South Route, Wild Isle, Archaeological Inventory, Utah Test and Training Range, Hill Air Force Base, Tooele County, TS-5, Paleoarchaic, Basalt			15. NUMBER OF PAGES 86 + Appendices	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT Unclassified	18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified	19. SECURITY CLASSIFICATION OF ABSTRACT Unclassified	20. LIMITATION OF ABSTRACT UL	

HILL AIR FORCE BASE

CULTURAL RESOURCES INVENTORY OF THE SOUTH ROUTE TO WILD ISLE AND TS-5, UTAH TEST AND TRAINING RANGE, TOOELE COUNTY, UTAH



**HEADQUARTERS AIR COMBAT COMMAND
JUNE 2003**

MANAGEMENT SUMMARY

The U.S. Army Corps of Engineers, Fort Worth District, contracted with Geo-Marine, Inc. (GMI), to provide cultural resources services for a U.S. Air Force Air Combat Command project on the South Air Force Range of the Utah Test and Training Range (UTTR). UTTR is under the jurisdiction of Hill Air Force Base and located in Tooele County, Utah. An archaeological inventory was undertaken in August 2001 for a southern access route, referred to as the "South Route," to the Target Site 5 (TS-5) target complex located on the Wild Isle dune field. Entry to Wild Isle from the northern access road is often prohibited due to military testing and training exercises in the Wildcat-Kittycat mountain area. The South Route begins at the Sand Island target complex and extends 18.4 miles to the west side of Wild Isle dune field where it enters the TS-5-2 target. The inventory was conducted under Antiquities Annual Permit No. U-01-GM and in compliance with the National Historic Preservation Act of 1966, as amended through 2000.

The South Route inventory resulted in the recordation of nine prehistoric sites and 37 isolated finds, all estimated to be over 8,500 years old. These are largely basalt and obsidian stone artifact scatters. The survey route crosses open mud flats and the remnant channels of the Late Pleistocene/Early Holocene-era Old River, which drained the Sevier Basin into Lake Bonneville prior to, and possibly during, human occupation. This context provided a unique opportunity to observe archaeological materials relative to the ancient channels that watered an extensive wetland; these channels are not as observable at Wild Isle, where previous work has been conducted, and sand dune coverage obscures relationships.

The sites are surficial and possess no potential for buried deposits. Based on this lack of integrity and the redundant nature of their lithic artifact assemblages, the South Route sites are not considered eligible for inclusion on the National Register of Historic Places (NRHP). Combined, however, along with the material from previous Wild Isle surveys, they provide additional insights into Paleoarchaic lifeways.

TABLE OF CONTENTS

MANAGEMENT SUMMARY	iii
ACKNOWLEDGMENTS	xi
1. INTRODUCTION	1
Archaeological Overview	1
Project description	2
Previous Work in the Wild Isle area	2
Terminology	5
Report Structure	5
2. ENVIRONMENTAL CONTEXT	7
Modern Setting	7
Past Environments	7
Lake Bonneville and the Old River	7
Paleoemarsch Benefits to Human Inhabitants	11
3. CULTURAL CONTEXT	15
Cultural Overview	15
The Paleoarchaic: More "Paleo" or "Archaic"?	15
Post-Paleoarchaic Changes	18
Wendover Period	18
Black Rock Period	19
Fremont	20
Late Prehistoric and Indigenous Peoples	22
4. RESEARCH DESIGN	23
Great Basin Hunter-Gatherers	23
Lithic Technology	24
Tool Reduction and Technological Organization	24
Stone Tools and Mobility	25
Toolstone Selection	26
Lithic Economy and Toolstone Quality	28
Research Questions	29

Table of Contents
(cont'd)

5. METHODS	33
Field Methods	33
Laboratory Analysis.....	34
Stone Tool Analysis	34
Flaked Stone Tools.....	34
Debitage	35
Ground stone	36
6. INVENTORY FINDINGS	37
Isolated Artifacts.....	37
Archaeological Sites	37
42TO1863.....	39
42TO1864.....	40
42TO1865.....	43
42TO1866.....	43
42TO1867.....	47
42TO1868.....	52
42TO1869.....	55
42TO1870.....	55
42TO1871.....	59
Summary.....	61
7. CONCLUSIONS	63
Research Questions.....	63
8. SUMMARY AND RECOMMENDATIONS	69
Research Values and Recommendations for future work.....	69
Recommendations for NRHP Eligibility	70
REFERENCES CITED	73
APPENDICES	
A: Debitage Recording Forms	A-1
B: Artifact Catalog.....	B-1

LIST OF FIGURES

1. Map of the South Route project area showing locations of previous investigations, archaeological sites, and isolates.....	3
2. Overview of South Route terrain showing barren mud flat surface.....	8
3. Overview of South Route terrain showing pickleweed and coppice dunes	8
4. The South Route and Wild Isle relative to important Lake Bonneville shorelines	10
5. Orthophoto showing South Route sites relative to Wild Isle and Old River channel features	12
6. Projectile points collected on the South Route inventory	38
7. Overview looking toward Wildcat Mountain and the Cedar Mountains of 42TO1868 showing alternating coppice dunes and paleochannels	39
8. Overview looking toward Granite Peak of site 42TO1871 showing barren mud flat context	40
9. Plan map of site 42TO1863	41
10. Stone tools from site 42TO1863	42
11. Plan map of site 42TO1864	44
12. Stone tools from site 42TO1864	45
13. Plan map of site 42TO1865	46
14. Stone tools from site 42TO1865	47
15. Plan map of site 42TO1866	48
16. Stone tool from site 42TO1866.....	49
17. Plan map of site 42TO1867	50
18. Stone tools from site 42TO1867	51
19. Ground stone from sites 42TO1867 and 42TO1868.....	51
20. Plan map of site 42TO1868	53
21. Stone tools from site 42TO1868	54
22. Plan map of site 42TO1869	56
23. Stone tools from site 42TO1869	57
24. Plan map of site 42TO1870	58
25. Stone tools from site 42TO1870	59
26. Plan map of site 42TO1871	60
27. Stone tool from site 42TO1871.....	61
28. South Route archaeological sites adjacent to Old River gravel channels	64

LIST OF TABLES

1. Legal Description of South Route Location.....	5
2. Major Lake Bonneville Shorelines.....	11
3. Eastern Great Basin Culture Sequence	16
4. Debitage Recorded as Isolated Finds	38
5. Debitage Recorded at Site 42TO1863.....	42
6. Debitage Recorded at Site 42TO1864.....	45
7. Debitage Recorded at Site 42TO1865.....	47
8. Debitage Recorded at Site 42TO1866.....	49
9. Debitage Recorded at Site 42TO1867.....	52
10. Debitage Recorded at Site 42TO1868.....	54
11. Debitage Recorded at Site 42TO1869.....	57
12. Debitage Recorded at Site 42TO1870.....	59
13. Debitage Recorded at Site 42TO1871.....	61
14. National Register of Historic Places Eligibility for South Route Sites.....	71

ACKNOWLEDGMENTS

Geo-Marine, Inc. would like to thank Dr. Paul Green of the U.S. Air Force Air Combat Command, Mr. Martyn Tagg of the Air Force Materiel Command, Mr. Sam Johnson of Environmental Management, and Mr. Tom Nass of the 388th Range Squadron for their involvement in this project. These individuals were integral in implementing plans that allowed for responsible management of cultural resources concerns while achieving the Air Force mission on UTTR. Dr. Jay Newman of the U.S. Army Corps of Engineers, Fort Worth District, also provided advice. Hill Air Force Base Archaeologist Ms. Jaynie Hirschi was instrumental in providing information about the archaeology of Wild Isle, as was Dugway Proving Grounds archaeologist Ms. Kathy Callister who provided information about related archaeological data south of the project area. Ms. Hirschi's assistance in the field is also greatly appreciated. Target Manager Mr. Tom Nass, Target Supervisor Mr. Bob Thornton, and the entire 388th target crew were always enjoyable and helpful in the field. Finally, thanks also goes to Mr. Jim Carter of Historic Research Associates, Inc., and Mr. Craig Young of Far Western Anthropological Research Group, Inc., for eagerly discussing their knowledge of the archaeology and geomorphology of Wild Isle based on their previous work.

CHAPTER 1 INTRODUCTION

In August 2001, Geo-Marine, Inc. (GMI), conducted an archaeological inventory of an 18.4-mile access route, termed the "South Route," to the Target Site 5 (TS-5) target complex, located on the Wild Isle dune field, on the Utah Test and Training Range (UTTR) (Figure 1). The South Route is intended to provide access to the targets via a southern entry. Wild Isle access is often restricted along the only existing access road, which enters its north side, due to military testing and training exercises that take place in the Wildcat Mountain and Kittycat Mountain areas. GMI is contracted by the U.S. Army Corps of Engineers (USACE), Fort Worth District, to provide cultural resources services for U.S. Air Force Air Combat Command (ACC) projects on UTTR. This area is under the jurisdiction of Hill Air Force Base (HAFB) and located in Tooele County, Utah. ACC and the 388th Range Squadron, as HAFB and U.S. Air Force Materiel Command tenants on UTTR, facilitate cultural resources investigations initiated by their activities.

ARCHAEOLOGICAL OVERVIEW

The greater Wild Isle area, which is defined here as portions of UTTRs South Air Force Range extending south to the Dugway Proving Grounds boundary and east to Wildcat Mountain from Wild Isle, has proven to be a unique reservoir of archaeological data on the early cultures of the eastern Great Basin. Lithic artifacts of the Western Stemmed Tradition (WST) are found almost exclusive of later material across an area spanning approximately 25 kilometers (km) to the south toward Granite Peak and east toward Wildcat Mountain. Military ownership has protected these lands from casual collecting by the public.

People exploited a rich wetland ecosystem that existed over 8,500 years ago. At that time, drainages related to the Old River system entered the ancient Lake Bonneville margin in the Wild Isle area. When these drainages dried, the wetland disappeared and people discontinued use of the area. The sites recorded along the South Route are not singularly capable of answering questions important to prehistory, a requirement for status on the National Register of Historic Places (NRHP); they are redundant and non-specific lithic scatters with no vertical integrity remaining after roughly 10 millennia. Taken together, however, they do provide insight into the ancient lifeways of those that relied on this once exceptional area.

PROJECT DESCRIPTION

The inventory took place August 13-15, 2001, by GMI archaeologist Daron Duke and HAFB archaeologist Jaynie Hirschi. This work was conducted under State of Utah Antiquities Annual Permit No. U-01-GM, in compliance with Section 106 of the National Historic Preservation Act of 1966, as amended through 2000 [16 U.S.C. § 470 et seq., P.L. 89-665, Stat. 915] and the National Environmental Policy Act (NEPA) of 1969 (P.L. 91-190; 83 Stat. 852).

Archaeological sites were assessed for NRHP eligibility according to specific research questions regarding the significance of sites to regional prehistory. These questions were generated from a thorough review and synthesis of existing cultural-historical, environmental, and archival information. This information is detailed in this document in a manner consistent with guidelines in the Department of *Interior's Archaeology and Historic Preservation: Secretary's Standards and Guidelines* (1983); the Department of Defense Directive 4710.1, *Archaeological and Historical Resources Management*; and the U.S. Air Force Policy Directive 32-70.

The South Route begins in Township (T) 5 South (S), Range (R) 13 West (W), Section 36 (at the Sand Island target complex), and extends to T 5 S, R 15 W, Section 35 where it turns north, terminating in T 4 S, R 15 W, Section 34. All of the sections are listed in Table 1.

From Sand Island, the South Route heads virtually due west 12.6 miles where it turns north-northwest and continues 5.8 miles to Wild Isle. At this point, the route rises off the open mud flats onto the dune field, meeting with access roads associated with target TS-5-2. These roads and the TS-5-2 target area were the subject of previous monitoring efforts by GMI (Duke 2002). Multiplied by a 400-ft corridor, the inventory totals 891 acres.

PREVIOUS WORK IN THE WILD ISLE AREA

Four previous cultural resource inventories have been conducted in the project vicinity and constitute a 100 percent survey of the Wild Isle dune field. Arkush (1997) surveyed the "Central Area," which is a 1.25-mile-wide corridor that runs the length of the middle of the landform north-south, and recorded two sites, both possessing WST projectile points diagnostic of the Paleoarchaic era. Another inventory by Weder and Ugan (2000) resulted in two more sites. Survey by Historic Research Associates, Inc. (HRA), in the remaining portions of the dune field (Carter 1999), as well as a resurvey of the Central Area (Carter and Young 2002), resulted in the recording of 91 more sites. These are typically lithic scatters dominated by basalt and obsidian located in dune blowouts, many of which date to the Paleoarchaic based on the presence of stemmed points. Archeological monitoring of TS-5-2 development at Wild Isle provided further geomorphological evidence that these sites underlie the existing dunes (Duke 2002). Other surveys on UTTR have been conducted near Wildcat Mountain (Arkush 1994, 1995, 1997; Arkush and Workman 1993a; Arkush et al. 1992), and synthesis of these surveys as they relate to the Paleoarchaic time period and the WST can be found in Arkush and Pitblado (2000).

Table 1
Legal Description of South Route Location

East to West	South to North
T 5 S, R 13 W, Sections 31-36; USGS 7.5' <i>Wildcat Mountain SE, UT</i>	T 5 S, R 15 W, Section 35, 26, 23, 14, 15, 10, 3; USGS 7.5' <i>Wildcat Mountain SW, UT; West of Wildcat Mountain SW, UT</i>
T 5 S, R 14 W, Sections 31-36; USGS 7.5' <i>Wildcat Mountain SE; Wildcat Mountain SW, UT</i>	T 4 S, R 15 W, Section 34; USGS 7.5' <i>South of Arinosa SE, UT</i>
T 5 S, R 15 W, Section 35-36; USGS 7.5' <i>Wildcat Mountain SW, UT; West of Wildcat Mountain SW, UT</i>	

TERMINOLOGY

To avoid confusion, it must be noted that the term "Wild Isle" is used in this report to indicate the dune field where the South Route terminates rather than "TS-5," as it has been called in previous cultural resources reports. Wild Isle is a name used in the past to identify the area prior to target development. This label is preferable to clarify the distinction between the landform itself—which is the subject of much discussion and reference in this report—and those locations specifically designated as targets. Only the targets themselves and associated access roads situated on Wild Isle comprise the TS-5 target complex. There are many archaeological sites at Wild Isle, and these are not currently being subjected to explosive testing and training activities. Where targets have been developed, or may be in the future, the 388th Range Squadron works to select areas with the least potential for impacts to archaeological sites in accordance with its mission. Both the surface and subsurface at proposed locations are then intensively monitored by qualified archaeologists to ensure protection of important cultural resources.

REPORT STRUCTURE

This report details inventory methods and findings, and presents recommendations for South Route cultural resources. The environmental and cultural contexts are presented in Chapter 2 and Chapter 3, respectively. The research design and research questions are provided in Chapter 4, followed by the field and research methods in Chapter 5. Descriptions of each site found on the South Route inventory are presented in Chapter 6. Research questions are addressed in Chapter 7. A brief summary of findings and recommendations for future research are provided in the final chapter, Chapter 8. Also found in Chapter 8 are the NRHP eligibility recommendations for each site in addition to future management considerations.

CHAPTER 2

ENVIRONMENTAL CONTEXT

MODERN SETTING

In the southern Great Salt Lake Desert, the South Route crosses alternating areas of barren mud flat (Figure 2) and transient coppice dunes that shift their position according to the life and death of sparse pickleweed plants (*Allenrolfea occidentalis*) (Figure 3). Jack rabbits (*Lepus californicus*), cottontails (*Sylvilagus audubonii*), and various small rodents can be seen occasionally, but visible animal life on the playa is otherwise almost non-existent. The route also crosses linear berm-like features in some areas. These are remnant levees of the ancient Old River drainage system that stand in relief from the surrounding playa surface. This distributary system was important to prehistoric occupants, and is discussed in detail further below.

As the South Route rises onto the west side of Wild Isle it enters a different environmental setting. Wild Isle is so named for its distinction from the surrounding mudflats, but the dune field did not exist during early occupations and has never been an "island" surrounded by waters of the Great Salt Lake or ancient Lake Bonneville. The dunes themselves probably began forming shortly after early occupations, seating themselves on the topographic relief of desiccated deltaic channel features (Carter and Young 2002:29). The vegetation is desert scrub, consisting of plants such as pickleweed, greasewood (*Sarcobatus vermiculatus*), shadscale (*Atriplex confertifolia*), and various grasses. Small mammals, reptiles, and birds are common.

Only a small portion of the South Route is located on Wild Isle, and the interested reader is referred to detailed environmental discussions in previous survey reports by Arkush (1997), Carter (1999), and Carter and Young (2002). The modern environment is of no relevance to early use of the area over 9,000 years ago, when an expansive wetland existed.

PAST ENVIRONMENTS

Lake Bonneville and the Old River

The current desolate landscape bears little resemblance to the environs present at the time of human occupation. The Pleistocene-Holocene transition in North America represents a shift from a colder and wetter environment to one that became warmer and dryer over the last 10,000 years. Numerous lakes existed in the Great Basin during the Pleistocene "Ice Age," when increased

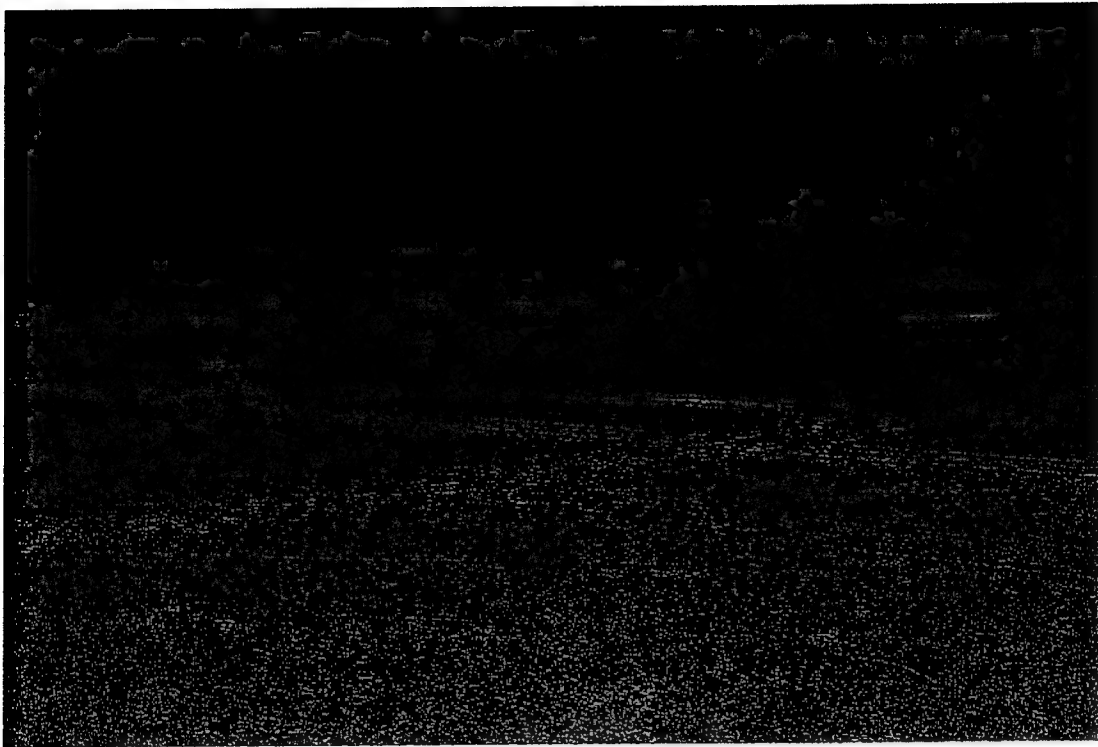


Figure 2. Overview of South Route terrain showing barren mud flat surface.

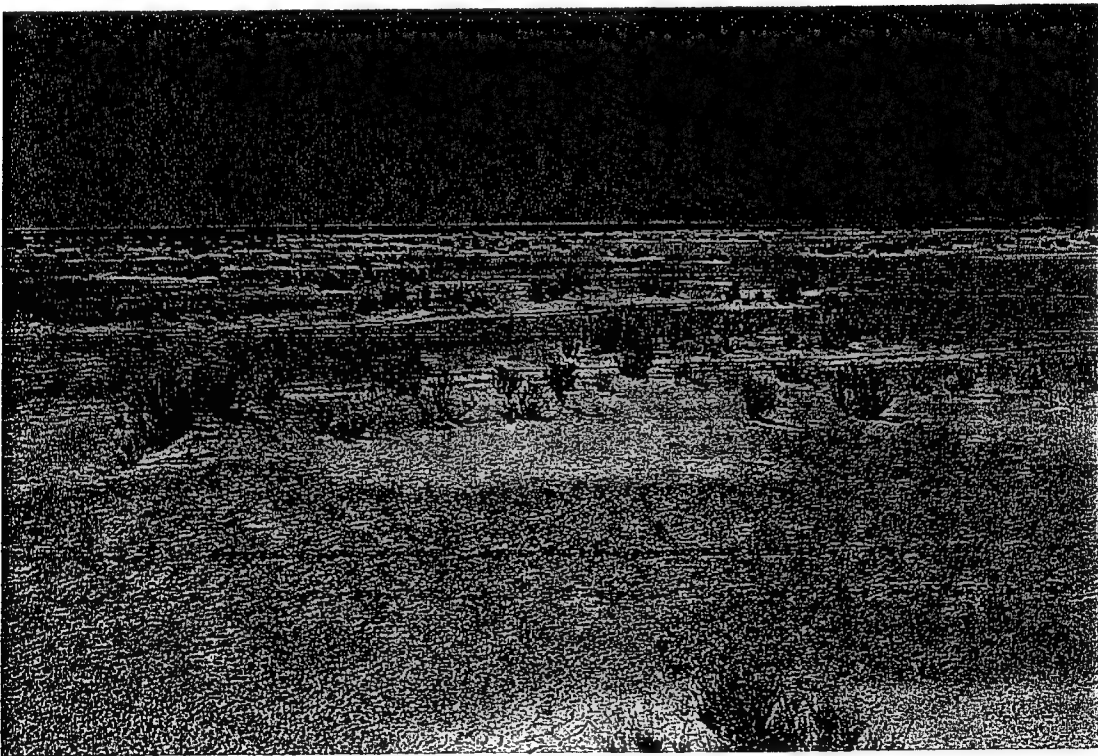


Figure 3. Overview of South Route terrain showing pickleweed and coppice dunes.

precipitation and mountain runoff fed large internally drained basins at much greater rates than today. Neighboring basins became linked into massive pluvial lakes as water exceeded overflow thresholds. Over the course of hundreds of thousands of years this pattern fluctuated, with the most recent incarnation of Lake Bonneville beginning just over 30,000 years ago and lasting to the end of the Pleistocene (Currey and Oviatt 1985; Madsen 2000; Oviatt et al. 1992). Much of the Bonneville Basin is currently recognized as the Great Salt Lake Desert, the Great Salt Lake being the last remnant of this ancient lake.

As part of the Bonneville Basin, the South Route area has been under the water of Lake Bonneville several times, and by at least 30 m (100 ft) during highstands (Currey 1980, 1982, 1990; Oviatt 1997; Oviatt et al. 1992, 1994). For much of this time the Old River drained the Sevier Basin, and resident pluvial Lake Gunnison (Currey and James 1982:34), into Lake Bonneville, serving as the major waterway entering what is now the project area from the southeast (Gilbert 1890; Oviatt 1988; Oviatt et al. 1994:3) (Figure 4).

Stable lake stands are important reference points for lake history reconstruction (Table 2; see Figure 4). These are visible as erosional strandlines on surrounding mountain ranges. The most recent lake stand relevant to the project area is the Gilbert level, or the Gilbert Shoreline, which is believed to have covered the area between 10,900 and 10,300 radiocarbon years ago (Currey 1990; Oviatt et al. 1992). At that time, Wild Isle and the South Route project area would have been underwater, the shoreline located less than 20 km to the southeast. Although it is possible that people were in the region prior to the Gilbert transgression (i.e., lake rise), extensive human occupation probably did not occur until post-Gilbert times.

Several factors contribute to reconstructing the local landscape of the past, and the interplay among them is the subject of ongoing investigation by researchers. Study of paleo-distributary features at Wild Isle indicates that a broad network of stream channels consisting of silt and sand-filled swales, and bedded silt and fine sand levees criss-crossed the area (Carter and Young 2002:19; also see Young 2002a, 2002b:14-20). These features are more resistant to erosion than the surrounding playa, which has deflated around them. This leaves the levees to remain as sandy berm-like features in relief from the surrounding flats. The adjacent channels themselves are also inverted in some cases where playa erosion has been extensive. These features have their greatest integrity within the dune field where erosional forces, especially wind, have been destructive. The paleo-streams themselves were part of a meandering, low-energy system that spread across the nearly level terrain approaching the lakeshore (Carter and Young 2002:27).

Chronology for the stream network is based on three terrestrial gastropod shell samples collected from three different channel fill locales. They date to $9,250 \pm 60$, $9,640 \pm 60$, and $10,830 \pm 70$ radiocarbon years ago (Carter and Young 2002:27). The earliest date suggests that the distributary system came into place following the Provo regression between 14,000 and 10,900 years ago, which means that it was probably inundated by the Gilbert transgression. Geomorphologic data also indicate that it is possible that another post-Gilbert transgression of the lake impacted the Wild Isle and South Route areas (Craig Young, Jack Oviatt; personal communication), but this has not yet been determined. More dates are needed to clarify lakeshore level changes, and how they relate to prehistoric occupations near Wild Isle.

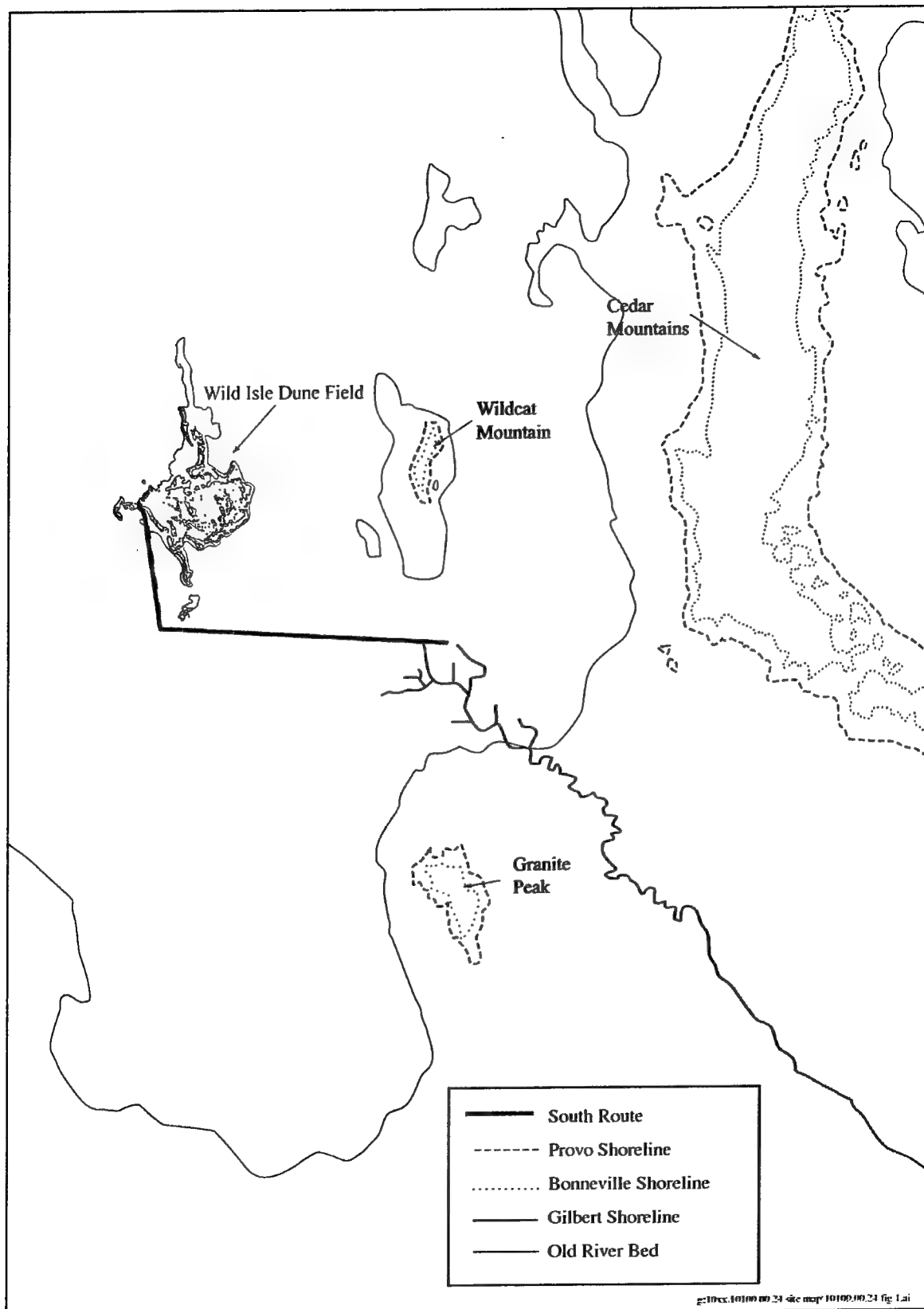


Figure 4. The South Route and Wild Isle relative to important Lake Bonneville shorelines.

Table 2
Major Lake Bonneville Shorelines

Name	Duration*
Stansbury	22,000-20,000
Bonneville	15,000-14,500
Provo	14,500-14,000
Gilbert	10,900-10,300

*radiocarbon years before present
(Madsen 2000; Oviatt 1997)

The water draining through the project area came from several sources. The Old River itself may have had variable flow during regressive lake periods bracketing the Gilbert rise. While the post-Provo low-stand receded to near modern water levels of the Great Salt Lake (although it remained more expansive because of minimal isostatic rebound [Madsen 2000:15]), a more northerly pattern of summer monsoonal moisture at that time probably kept pluvial Lake Gunnison at higher levels, and the Old River flowing (Oviatt 1988, 1989:33-34; Oviatt et al. 1994). The Old River may have shut down in early post-Gilbert times, although groundwater discharge from basin margins could have been sufficient to maintain stream flow (Madsen et al. 2000).

Distinctive gravel channels are reported on Dugway Proving Grounds to the south of the project area. These channels are distinctive indicators of higher energy flow associated with the Old River (Oviatt and Madsen 2000). Similar channels filled with pea-size gravels extend as far north as the South Route (Figure 5), but are not as yet apparent at Wild Isle. The extent to which the Wild Isle sand channels represent the deltaic remnants of Old River flow versus groundwater discharge is not yet known. Based on the current evidence, it seems likely that the Wild Isle channels represent groundwater discharge that simply followed the pre-existing drainage system rather than the Old River flowing at full strength.

Paleoemmarsh Benefits to Human Inhabitants

The distributary channels feeding into the greater TS-5 area provided an extensive marsh network full of potential resources. This area was set against the backdrop of a sagebrush-grass, and probably shadscale, steppe environment (Grayson 1993:143-147). The marsh system consisted of numerous linear and localized marsh areas (Carter and Young 2002:28), although the water was probably slightly saline (Currey 1982:192). Useful wetland plants such as cattail (*Typha* sp.), bullrush (*Scirpus* sp.), and sedge (*Carex* sp.), fluctuating according to water level and salinity, were surely available (see native plant and animal use discussions by Fowler 1990; Kelly 1985, 2001; Simms 1984, 1987). Additional mesic plants include pondweed (*Photomageton* sp.), saltgrass (*Distichlis spicata*), spikerush (*Eleocharis* sp.), water plantain (*Alisma geyeri*), and duckweed (*Lemna* sp.). These species could have been components of a whole suite of grassy, herbaceous, and emergent plant resources of varying nutritional, medicinal, and economic value.

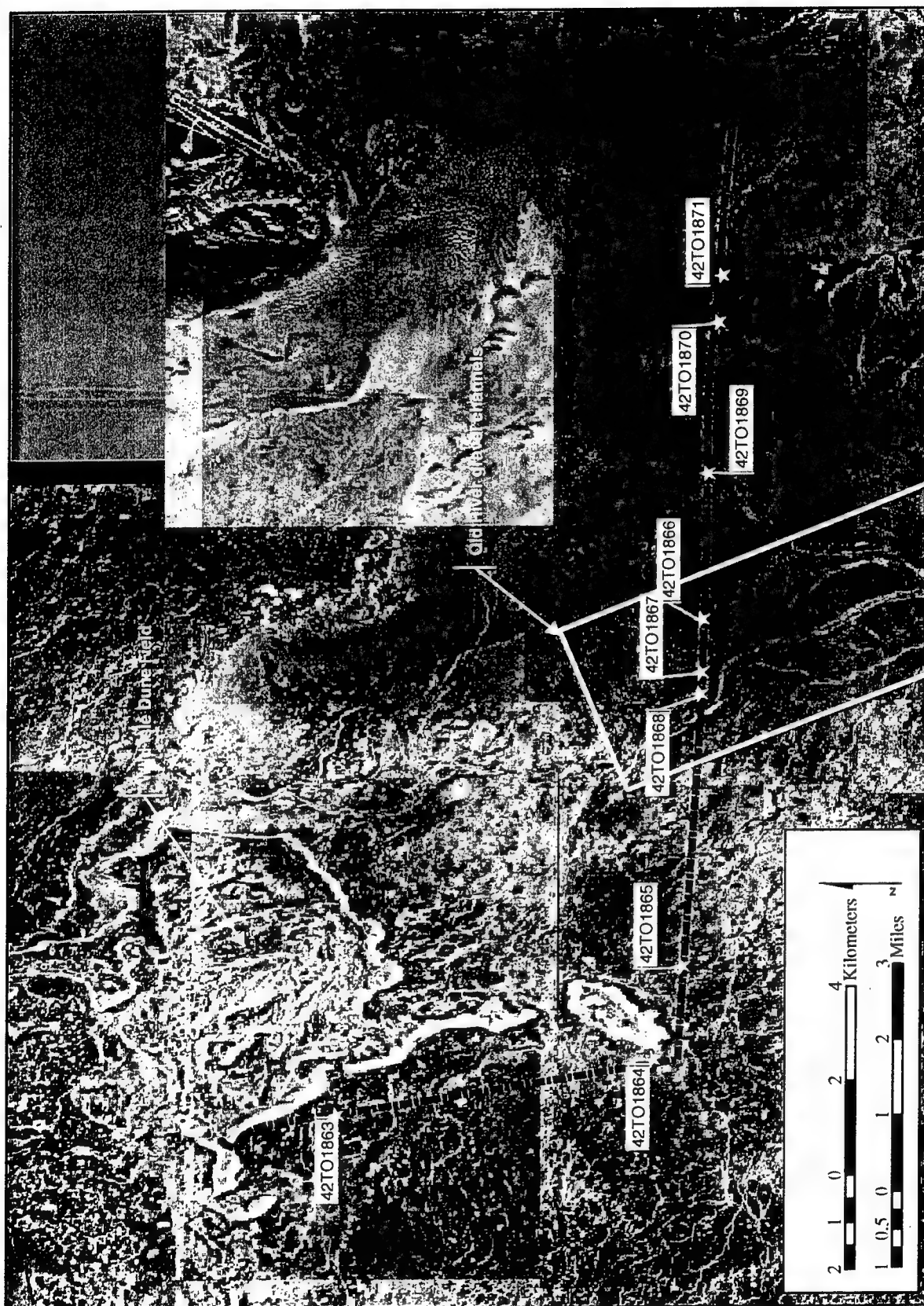


Figure 5. Orthophoto showing South Route sites relative to Wild Isle and Old River channel features.

Many animal resources would have also been available as part of the wetland ecosystem. The wetter Pleistocene-Holocene environment may have even possessed greater productivity than later in time, which would have further contributed to this abundance (Grayson 1998; Nowak et al. 1994). Small rodents in particular, such as rats (*Dipodomys* sp.), mice (*Perognathus* sp., *Peromyscus* spp.), squirrels (*Citellus* sp., *Spermophilus* sp.), gophers (*Thomomys* sp.), and voles (*Microtus* spp.), were likely food items, although larger small mammals including muskrats (*Ondatra* sp.), rabbits (*Sylvilagus* sp., *Lepus* sp.), and badgers (*Taxidea taxus*) were no doubt available. Various amphibians and reptiles could have also been part of the small animal diet. Large game animals likely included pronghorn antelope (*Antilocapra americana*), mule deer (*Odocoileus hemionus*), and probably bison (*Bison* sp.). Bighorn sheep (*Ovis canadensis*) and mountain goats (*Oreamnos* sp.) were surely present in the neighboring mountainous areas of Wildcat Mountain (15 km), Granite Peak (30 km), the Deep Creek Range (30 km), and the Cedar Mountains (30 km), but not in the immediate area.

Waterfowl, shore birds, and fish, as well as their eggs, could have been exploited. Ducks (*Anas* sp.), coots (*Fulica americana*), pelicans (*Pelicanus erythrorhynchos*), terns (*Sterna* sp.), grebes (*Prodicops* sp.), geese (*Branta canadensis*), herons (*Ardea herodias*, *Nycticorax nycticorax*), and killdeer (*Charadrius vociferous*) are common Great Basin wetland birds. The higher, and thereby less saline, lake level also supported several species of fish, as evidenced in dated deposits from dry shelters (Grayson 1993:Table 7-18; Madsen 2000). These included Lake Bonneville species of whitefish (*Prosopium spilonotus*) and cisco (*Prosopium gemmiferum*), as well as Bear Lake sculpin (*Cottus extensus*), mottled sculpin (*Cottus bairdi*), Utah sucker (*Catostomus ardens*), Utah chub (*Gila atraria*), June sucker (*Chasmistes liorus*), and cutthroat trout (*Salmo clarki*).

Studies at Stillwater Marsh in western Nevada indicate that fluctuations in precipitation, and thereby water levels, and related climatic factors can significantly alter the resource base of wetlands from season-to-season and year-to-year (Fowler 1990; Kelly 1985, 2001; Thomas 1983), although these areas were clearly prehistoric focal points (Raymond and Parks 1990). Sites in the Stillwater area, while not necessarily indicative of early subsistence patterns, show a high occurrence of small mammal remains, especially voles, muskrats, and rabbits (Schmitt and Sharp 1990). Site formation processes notwithstanding (see Grayson 1983), the high return rates for small animal remains in the prehistoric record suggest that these remains be interpreted as cultural in origin rather than a natural occurrence (Simms 1984:182-183). Bighorn sheep remains indicate that late stage butchered cuts were brought to sites in the wetlands. Ground stone artifacts indicate that seeds were important, undoubtedly used along with various roots, shoots, and tubers. Fish were taken at Stillwater Marsh, comprising over 85 percent of the vertebrate assemblage (Kelly 2001:281). Diverse species of birds including both waterfowl and shore birds were also exploited (Livingston 2001; also see Fowler 1990). Drews (1990) points out the value of freshwater mussel (*Anodonta* sp.) as a possible dietary component.

The Stillwater case supports other Great Basin archaeological and ethnographic data that indicate diverse diet breadth, consisting primarily of small food packages, in wetland areas. This scenario cannot be directly extrapolated for the South Route project area during the Pleistocene-Holocene transition, but it does provide one well-researched point of reference. Moreover, early peoples probably did not incorporate as many lower-ranking foods as later groups, especially seeds, which require considerable processing time (Simms 1984:183-184). The question of how rich and reliable marsh areas were for human use is still debated (see Kelly 1985:81, 2001; Madsen 1982a; Madsen and Janetski 1990; Thomas 1983).

The inhabitants of the greater Wild Isle area clearly found it a desirable place. Among the braided network of low-energy streams, they would have lived and worked on the associated divides and levees. A number of sand channels were mapped and described at Wild Isle (Carter and Young 2002:19-29), but more subtle channel features meander all across the area. Carter and Hirschi (2002) tested the idea that there is a direct relationship between the location of prehistoric sites, artifact types, and the mapped channels. They found no correlation. This suggested to them that channels shifted around substantially while the wetlands existed, and people shifted their activities alongside them, leaving a record that is as widespread and abundant as the sand channels. When the marshes dried up about 9,000 years ago, people abandoned the area with little incentive to return.

CHAPTER 3

CULTURAL CONTEXT

The greater Wild Isle area is unique for its abundance of Paleoarchaic sites and stone tools. Lithic items largely consist of basalt and obsidian flaked stone artifacts composed of bifaces, flake tools, debitage, and WST projectile points. At Wild Isle, these sites are located in dune blowouts where mudflat surfaces are exposed. Later cultural materials, of which there are few, are related to limited transient activities on the dune field much as it is seen today. Since the South Route crosses open mudflats, it was considered likely that the sites and artifacts encountered would be exclusively Paleoarchaic. This chapter focuses on the environmental and technological adaptations of this cultural era. Later periods are briefly discussed, and the hallmarks of the full regional chronology are summarized in Table 3.

CULTURAL OVERVIEW

The Great Basin suffers from a lack of dated archaeological materials compared to other regions. Open-air lithic scatters that lay on deflated surfaces are the prototypical site types. Much of what is known about the regional cultural chronology comes from caves and rockshelters that possess buried and stratified deposits. Eastern Great Basin caves such as Hogup Cave (Aikens 1970), Smith Creek Cave (Bryan 1979), Sudden Shelter (Jennings et al. 1980), Danger Cave (Jennings 1957), and Homestead Cave (Madsen 2000) have provided valuable archaeological and paleoenvironmental information (see Aikens and Madsen 1986). Previous inventories conducted on UTTR have recorded many open-air sites in the Great Salt Lake Desert (Arkush 1993, 1994, 1995, 1997; Arkush and Workman 1993a, 1993b; Arkush et al. 1992; Carter 1999; Carter and Young 2002; also see Arkush and Pitblado 2000).

THE PALEOARCHAIC: MORE "PALEO" OR "ARCHAIC"?

"Paleoarchaic" is a catch-all designation that generally corresponds with the Bonneville period and the WST, but may also include the fluted point tradition. Some overlap into the Wendover period is also likely. In other parts of North America, cultural traditions with such time depth are considered "Paleoindian," but the lifeway these people led is more suggestive of what is termed "Archaic" in other regions, and usually associated with post-Paleoindian hunter-gatherer

Table 3
Eastern Great Basin Culture Sequence¹

Cultural Era	Adaptive Strategies
<div> <div>Paleoarchaic</div> <div> <p><i>Paleoindian</i> (12,000-10,500 B.P.²)</p> <p><i>Early Archaic</i> Bonneville Period (11,000-9,500 B.P.)</p> <p>Wendover Period (9,500-6,000 B.P.)</p> </div> </div>	<p>Rare in the Great Basin; land use centered on pluvial lakes and primary drainages; emphasis on hunting, and plants requiring little processing (as indicated by a lack of ground stone); toolstone focus was on higher grade material amenable to a sophisticated, highly curated technology</p> <p><i>Diagnostics: fluted points</i></p> <p>Usually referred to as the "Paleoarchaic" for its combination of Paleoindian and Archaic patterning; Bonneville period artifacts suggest high mobility, but land use appears conditioned by lake-margin resources rather than the movement of large game; limited ground stone; crude tools often made from coarse-grained material</p> <p><i>Diagnostics: WST points, crescents</i></p> <p>Population increase along lake margins where lowering Lake Bonneville exposed new freshwater springs, creating new marsh settings; intensive use of caves and dry shelters to access these areas</p> <p><i>Diagnostics: Humboldt, Pinto, Large Side-notched points, WST points</i></p>
<p><i>Middle Archaic</i> Black Rock Period (6,000-3,500 B.P.)</p>	<p>Land use moves away from lake margins into uplands; primary drainages and springs utilized; greater subsistence emphasis on seeds as indicated by greater ground stone sophistication; efflorescence of sites evidence of rapidly increasing population</p> <p><i>Diagnostics: Elko, Gypsum points</i></p>
<p><i>Late Archaic</i> (3,500-1,600 B.P.)</p>	<p>Continuation of the Black Rock period; further elaboration of ground stone; introduction of the bow-and-arrow ca. 2,000 B.P.; pinyon nut exploitation beginning; possible population reduction</p> <p><i>Diagnostics: Rosegate points</i></p>
<p><i>Fremont</i> (1,600-700 B.P.) Bear Creek Phase (400-1,000 B.P.) Levee Phase (1,000-1,350 B.P.)</p>	<p>Abrupt shift to horticulturalist and agriculturalist economies; sedentism and storage; ceramic use; Fremont groups continued to practice hunting and gathering as a component of their crop-oriented lifeway, especially in the UTTR area; increased sedentism and greater use of maize agriculture indicated in the Levee Phase</p> <p><i>Diagnostics: Rosegate and Desert Side-notched points, Great Salt Lake Gray and Promontory Gray ceramics, pithouses, corn</i></p>
<p><i>Late Prehistoric</i> (700-150 B.P.)</p>	<p>Hunting and gathering returns as the primary land use strategy; inhabitants are immediate ancestors of Paiute and Shoshone peoples; new projectile point styles may be evidence of the recent arrival of these Numic speakers</p> <p><i>Diagnostics: Desert Side-notched, Cottonwood points</i></p>
<p><i>Historic</i> (1850-1953 A.D.)</p>	<p>European contact; Mormon settlement</p> <p><i>Diagnostics: tin cans, glass, wooden structures</i></p>

¹see Aikens and Madsen (1986), Beck and Jones (1997), Carter (1999), Marwitt (1986), Willig and Aikens (1988)

²B.P.=before present

adaptations. There is still no unanimous view on Paleoarchaic lifeways, so the term remains useful. Detailed discussions of the Paleoindian-Archaic transition can be found in Willig and Aikens (1988) and Simms (1988; also see Grayson 1993:236-244; Simms 1984:175-191) and in Chapter 4, but several primary issues are summarized here with reference to archaeologically diagnostic elements.

The early cultures of the eastern Great Basin were not practicing either Paleoindian or Archaic adaptations in any classic sense. Activities were oriented toward lake margins and adjacent marsh areas that were rich in high-value emergent plants, fish, fowl, and small terrestrial animals. Bedwell (1973) referred to this adaptation in the western Great Basin as the "Western Pluvial Lakes Tradition." But lake-margin paleomarshes were not the only habitat that was utilized during the Paleoarchaic period. WST sites have also been reported in upland settings (e.g., Elston and Bullock 1994), especially in the western Great Basin (e.g., Heizer and Elsasser 1953; Roney 1978; Rusco et al. 1979). Still, many such areas are situated in valleys that would have contained lake or lake tributary-associated marshlands. Although the restrictive term Western Pluvial Lakes Tradition has fallen out of favor among archaeologists, these patterns indicate that Paleoarchaic land use was conditioned to some extent by the location of lakes and associated drainages. Madsen (1982a) suggested that lake-margin marshes in the Bonneville Basin were sufficiently rich to have supported a semi-sedentary land use pattern. Willig (1989; also see Willig and Aikens 1988) described Paleoarchaic adaptations as "tethered" to mesic habitats. This contrasts with the classic Paleoindian model of human land use operating according to the movements of large migratory game animals.

A focus on fixed resources suggests lower residential movement, but the material record also indicates that people were more mobile than later groups in the Archaic. Ground stone occurs at times and obsidian can occur at considerable distances from its geologic source (Beck and Jones 1990; Jones and Beck 1999). Beck and Jones (1990) found most of the obsidian in eastern Nevada's Butte Valley to be from Brown's Bench, approximately 200 km to the north. Arkush and Pitblado (2000) reported Brown's Bench obsidian in the Wildcat Mountain area, again covering a roughly 200 km distance. Other obsidian sources from the South Route project's vicinity are sourced at similar distances to the north and south (e.g., Malad, Black Rock), with Topaz Mountain the closest at 80 km to the south. It is widely believed by Great Basin archaeologists that obsidian was procured directly from sources by mobile Paleoarchaic groups rather than acquired through exchange (Arkush and Pitblado 2000:34-35; Beck and Jones 1990:294). Early peoples may have possessed great freedom of movement since population densities were low in contrast to later time periods (Elston 1982). Ground stone rarely occurs, and is portable, consisting of small grinding slabs and handstones (see Jennings 1957:209-213).

Lithic technology associated with the WST has been interpreted several ways with regard to Paleoarchaic activities and movements. Great Basin stemmed points can occur in refined forms, but are usually components of rudimentary toolkits containing various biface and scraper/chopper tools made from coarse-grained igneous stone. This technology and its regional variants were given a variety of names, including Western Lithic Co-Tradition (Davis et al. 1969), San Dieguito (Rogers 1958; Warren 1967; Warren and True 1961), Large Leaf-Shaped Biface Tradition (Bryan 1965), and Old Cordilleran Culture (Butler 1961), and have been interpreted as valuable for both butchering (Warren 1967) and woodworking (Davis 1968) tasks. These labels were largely abandoned by the 1970-80s with a marked shift in archaeological research orientation from typology to technological organization and resource optimization. A dominant theme in lithic

studies since that time has been an emphasis on stone tool production systems as they relate to the organization of technology. Rudimentary technologies and artifacts, especially bifaces, receive little attention either because they exhibit minimal production effort or they are assumed to represent rejected production items.

Roughly shaped stone tools, made from both basalt and obsidian, predominate in the greater Wild Isle area (Arkush and Pitblado 2000; Carter 1999; Carter and Young 2002). This implies reduced residential movement. The common occurrence of rudimentary points and associated tools at Great Basin sites counters the notion that mobile toolkits should be highly curated and maximize high-grade stone (e.g., Goodyear 1979). However, certain components of the Paleoarchaic toolkit, such as some flake tools, scrapers, and bifacial cores, were highly curated and made from cryptocrystalline silicates (CCS) (Beck and Jones 1990). Coarser grained stone is preferred in some areas of the Great Basin, but more characteristic is that the regionally abundant toolstone is the most widely used. Obsidian in particular is preferred for projectile points when available (Beck and Jones 1997; Amick 1995). Temporal control for the Paleoarchaic is poor, however, and many of these patterns could be chronological.

While the interplay among variables such as lakes versus uplands, plant and small animal versus large game reliance, and expedient versus curated technologies are not completely understood, a dependence on late Pleistocene/early Holocene wetland environments is clear. Activities associated with the Western Stemmed Tradition appear to have diminished alongside pluvial lake remnants, at different rates across the Great Basin (see Elston 1982:191-193; Grayson 1993:238-244; Madsen 1982a:213-215).

POST-PALEOARCHAIC CHANGES

Wendover Period

While the Bonneville period is usually included as part of the Early Archaic, it is the archaeological patterns of the Wendover period that are most characteristically Early Archaic. Greater continuity exists between the Paleoarchaic and Early Archaic occupations in the eastern Great Basin than in western areas (Aikens and Madsen 1986:154-155; Elston 1982:199; Madsen 1982a:213-215). During the Wendover period, lake margins continued to be used. Wetland environments may even have expanded as the regressing Lake Bonneville revealed new springs and lengthened spring-fed tributaries (Madsen 1982a:214). Caves were used extensively to access these areas, and Danger Cave (Jennings 1957), Hogup Cave (Aikens 1970), Deadman Cave (Smith 1952), Sandwich Shelter (Marwitt et al. 1971), and Black Rock Cave all contain substantial early Archaic deposits (Aikens and Madsen 1986). These caves may have been used as wintering sites (Madsen 1980). Danger Cave in particular contains extensive Early Archaic materials, and the neighboring town of Wendover, Utah provides the name for the regional period.

Early Archaic peoples made greater use of upland areas, probably for hunting at certain times of the year (Aikens and Madsen 1986). Pickleweed was used extensively in lowland areas as indicated at Danger and Hogup caves. Early Archaic subsistence resembles previous occupations more than later adaptations, although the regional population appears to have increased (Simms 1977). Diagnostic projectile points from the Early Archaic include Humboldt, Pinto, and Large

Side-notched varieties. Ground stone is common in cave sites, indicating an increased reliance on milled seeds. Early Archaic subsistence resembles previous occupations more than later adaptations, although the regional population appears to have increased (Simms 1977). Unique perishable artifacts such as coiled basketry, cordage, and bone tools are often associated with Early Archaic occupations in caves.

Black Rock Period

Approximately 6,000 years ago, an Archaic pattern more resemblant to the typical Great Basin model emerged in the Middle-Late Archaic Black Rock period. Widespread use of upland areas began (Aikens and Madsen 1986). This upland usage appears to have become an integral part of the seasonal round for Middle Archaic groups as the procurement of grassy plants such as ricegrass (*Oryzopsis hymenoides*) occurred in addition to hunting. The land use strategy was oriented toward water sources other than the dwindling large-margin marshes, and involved residential movements set to more wide-ranging resource schedules (Madsen 1982a). Important cave sites such as Danger Cave and Hogup Cave continued to be used, but no longer played such a central role to regional settlement organization.

Wetter climatic conditions returned to the eastern Great Basin by 3,500 years ago. This Neoglacial period probably reinforced upland land use with added moisture, but lake margins appear to have become less productive (Currey and James 1982). Diminished diet breadth is indicated at several cave sites in the Bonneville Basin, suggesting that rising lake levels encroached on spring-fed drainages that supported marshlands (Harper and Alder 1972; Mehninger 1986). Site occupations were reduced at Danger and Hogup caves (Madsen and Berry 1975), and human coprolites from Hogup Cave indicate that only a few plant species were being eaten. Previous occupations at these sites indicated a diverse subsistence base consisting of large and small game, shorebirds and waterfowl, and a wide variety of plants. Sites such as Fish Springs Cave that were situated well above the maximum Neoglacial lake level continued to be used intensively (Madsen 1982b). Abundant Elko and Gypsum style projectile points also attest to population increase and expansion into upland areas during the early Black Rock period. These point styles replaced earlier Pinto and Humboldt styles, and represent the use of atlatl projectile technology.

By the late Black Rock period populations apparently diminished (Madsen 1982a). This trend may indicate a response to a rise in lake levels submerging many freshwater springs and marsh areas (Madsen 1982a; Madsen and Berry 1975). Otherwise, land use and resource utilization patterns continued much as they did previously. For the Great Basin in general, the Late Archaic is most notably marked in the Great Basin-wide adoption of the bow-and-arrow. This change is identifiable by the occurrence of smaller stone arrow points known separately as Rose Spring and Eastgate, or collectively as the Rosegate series (Thomas 1981). These point styles become common late in the Black Rock Period (ca. 2,000 B.P.), but Elko points maintain a reduced role. The use of localized sources of toolstone, especially CCS, became more common further reflecting land use intensification. Other technological changes to basketry and ground stone were minor. The use of coiled and twined basketry continued, but one-rod-and-bundle foundation construction became dominant (Aikens and Madsen 1986). Indian hemp netting twine like that from earlier times is found. This netting is known ethnographically, and was apparently used throughout much of Great Basin prehistory to collect small animals, especially jackrabbit and cottontail. Pinyon exploitation may also have begun at this time (Madsen 1982a:216).

Fremont

The Fremont culture was established by 1,600 years ago and lasted 900 years to A.D. 1300 (Marwitt 1986). This marked distinct cultural change in the eastern Great Basin. Fremont peoples were sedentary horticulturalists who lived in small, scattered villages on alluvial fans near marshes and waterways (Madsen 1982a). The Fremont tended and planted wild crops and domesticated crops, although hunting and gathering remained important components of their subsistence strategy. Fremont culture has been enigmatic to Great Basin researchers since ties to the Southwest, through which defining influences must have come, are difficult to ascertain. Fremont beginnings appear to be pre-Basketmaker (Marwitt 1970), and ties to southern Arizona and New Mexico's Mogollon area are limited (Marwitt 1986). Fremont culture probably represents accommodations of Southwestern influences into indigenous Great Basin traditions (Marwitt 1986).

Settlement-subsistence patterns typical of the Black Rock Period characterize the first Fremont sites (Aikens and Madsen 1986). Many of the same sites are occupied, but some pottery and maize appear. Villages and farmsteads containing pit houses, above- and below-ground storage features, and corn-beans-squash horticulture were all prevalent by A.D. 800 (Aikens and Madsen 1986:160). In the northern and western portions of the Fremont area, which includes Hill AFB and UTTR, hunting and gathering maintained a primary subsistence role (Marwitt 1986).

The Fremont area largely consists of the current state of Utah and small portions of neighboring states. Fremont variability to some extent corresponds with the different environmental conditions in this large area. Five Fremont geographic variants are defined by Marwitt (1970): (1) Great Salt Lake, (2) Sevier, (3) Parowan, (4) Uinta, and (5) San Rafael. The first three are considered by Madsen and Lindsay (1977) to represent sub-variants of the more broadly conceived Sevier Fremont of the western basin region of the Fremont area. The Uinta and San Rafael variants lay east of the Wasatch Plateau, and are considered to be truer manifestations of Fremont. Key distinguishing traits are in the degree of sedentism and farming, and associated artifacts and features.

East of the Wasatch Plateau, the Uinta variant of northeastern Utah represents relatively short-lived settlements compared to the more established, although small, rancherias of the San Rafael variant (Marwitt 1986). Uinta Fremont sites indicate brief occupations relative to other variants. The temporal range of this variant was also short, at about 300 years (A.D. 650-950). Sites usually contain five or less shallow circular pit houses. Thin cultural deposits suggest that occupations were oriented more toward the seasonal acquisition of available resources than on maize agriculture. These patterns may relate to a shorter growing season in the generally higher elevation Uinta Valley area. Uinta Gray calcite-tempered grayware is diagnostic of the Uinta Fremont. San Rafael sites contain additional features such as wetlaid and dry-laid masonry dwellings and granaries, and plastered interior walls and slab-floor firepits. Site locations are more diverse, making use of low ridges and knolls and caves and rockshelters in addition to valley areas (Jennings and Sammons-Lohse 1981; Madsen 1975). Maize agriculture appears to have been crucial to San Rafael Fremont sedentism. Diagnostic ceramic types include the crushed igneous rock tempered Emery Gray, Ivie Creek Black-on-white, and Snake Valley Black-on-gray. Trade wares from the Mesa Verde and Kayenta areas to the south-southwest attest to some Anasazi influences.

The basin, or Sevier, Fremont variants are the most applicable to the Hill AFB and UTTR area. Sevier Fremont groups tended to rely more heavily on stable resource locations near lake margins rather than cultigens (Madsen and Lindsay 1977). This is especially true for the Great Salt Lake variant. Sites such as Bear River No. 1 and Injun Creek (Aikens 1966), Bear River No. 3 (Fry and Dalley 1979), and the Levee and Knoll sites (Shields and Dalley 1978) are located just above the modern average stillstand for the Great Salt Lake where saline soil prohibits maize horticulture (Marwitt 1986). These sites are occupied for access to mesic resources in a marsh environment. These patterns differ less than any Fremont variant from earlier hunter-gatherers, but some architecture is present. There is no stone masonry and no above-ground storage features, but Fremont storage pits are present.

The Great Salt Lake variant is attributed to the entire 900-year time frame for Fremont. It is divided into two phases by Fry and Dalley (1979): (1) Bear River Phase, and (2) Levee Phase. The Bear River Phase is dated at A.D. 400 to A.D. 1000 based largely on deposits at the sites of Bear River No. 1, Bear River No. 2, and Bear River No. 3 on the northeastern margin of the Great Salt Lake. These include short term-use campsites and small rancherias with shallow, temporary structures. Archaic-style Rosegate projectile points are diagnostic of the Bear River Phase. The Levee Phase is dated from A.D. 1000 to A.D. 1350 based on deposits at the Levee and Knoll sites. An increased, but still minor, reliance on maize agriculture is apparent. Greater sedentism is indicated by more substantial pit houses containing long ventilator or crawlway tunnel adjuncts similar to those typical of the Parowan Fremont (Marwitt 1986). Desert side-notched projectile points and Great Salt Lake Gray pottery is prevalent along with lesser amounts of Promontory Gray. Promontory Gray is uniquely manufactured in the Great Salt Lake area using a paddle-and-anvil method rather than the coil-and-scrape method typical of Fremont. A trend toward greater reliance on cultigens and sedentism extends south from the Great Salt Lake area with the Sevier and southernmost Parowan Fremont variants. Basin-oriented marshland exploitation continues to be important, but structural features and influences from the Virgin Anasazi are more apparent.

The Fremont culture designation is questioned by some as a viable taxonomic unit (Madsen and Lindsay 1977; Madsen and Simms 1998). It remains important to study Fremont sites in a case-specific manner relative to earlier and later regional archaeological patterns. Within the context of Great Basin prehistory, however, the Fremont time frame is singularly unique, and has utility in distinguishing Great Basin and Colorado Plateau cultural patterns (Marwitt 1986). Artistic elements also stand out that combine indigenous ideology and Southwestern influence. Most notable are clay figurines from southern Fremont areas. These figurines are crudely to finely modeled and there is evidence that they were painted; they are typically unfired. Clay figurines include both male and female items, possibly made or possessed as pairs (Morss 1954). Horned anthropomorphic figurines have been found in the Great Salt Lake area at Hogup Cave, and bear resemblance to Fremont rock art images (Tuohy 1986). Fremont rock art contains abundant anthropomorphic imagery, combined with various geometric and abstract shapes characteristic of earlier Great Basin traditions. These rock art representations vary from elaborate and refined in the Classic Vernal Style of northeastern Utah to the simpler San Raphael style found in other areas.

Late Prehistoric and Indigenous Peoples

Hunter-gatherer lifeways returned to the region during the Late Prehistoric by peoples ancestral to the modern Paiute and Shoshone (Madsen 1982a:219-221; Marwitt 1986:171). It is not known whether these groups replaced the Fremont or the shift simply represents in situ cultural changes. Linguistic data suggest there was an influx into the area of Numic-speaking peoples from southeastern California (Lamb 1958; also see Madsen and Rhode 1994), but good archaeological indicators of an ethnic replacement have not been identified (Duke et al. 2001; Elston 1994). An annual round characterized by small mobile groups utilizing upland settings in the summer and congregating in the valleys during the fall to harvest pinyon pine nuts and winter in larger groups was likely the pattern for most areas (Steward 1938).

Late Prehistoric archaeological patterning is similar to that during the Black Rock period, but the use of more confined spaces is apparent. This is likely a product of increased population densities (Elston 1982). Late Prehistoric groups exhibit greater resource intensification through elaborations in ground stone and basketry technology and increased diet breadth (Bettinger and Baumhoff 1982). Lower ranked seed items were incorporated into the diet through more sophisticated processing techniques and the role of hunting was diminished. Lithic technology also reflects this land use pattern. Increased use of small local sources of raw material, especially CCS, is apparent. Reduction strategies are less refined since the curatorial requirements for stone tools were diminished. Biface and core-flake reduction technologies are represented at sites to varying degrees depending on toolstone availability and site function. Desert Side-notched and Cottonwood series projectile points are diagnostic indicators of this period.

The Western Shoshone-speaking Gosiute peoples represent the native inhabitants of the Hill AFB and UTTR area. They were mobile hunter-gatherers at the time of European contact, moving seasonally within the southern Great Salt Lake Desert-eastern Nevada region (Malouf 1974; Steward 1938; Thomas et al. 1986). Gosiute groups tended to aggregate around water sources in valley and mountain foothill areas such as the Deep Creek Mountains, Skull Valley, and Trout Creek areas of western Utah and eastern Nevada. Hunting of bighorn sheep and pronghorn antelope took place the mountain foothill areas while lowland plant resources and small game provided the bulk of the Gosiute diet.

CHAPTER 4

RESEARCH DESIGN

The most general chronological information continues to be highly sought-after for the Paleoarchaic. The material record is scant and intact deposits are virtually nonexistent. Dateable deposits were unlikely for the current project, but within the confines of the Paleoarchaic, South Route sites were expected to be pure. Because the project area was only useful when well-watered, there was unlikely to be an overlay of later artifacts.

The combination of abundant and diagnostic archaeological material makes the project area a uniquely robust field laboratory for examining Paleoarchaic patterning. The research questions developed for the South Route inventory center on lithic technology and its capacity to represent prehistoric systems. South Route sites were not expected to contain the stratigraphic deposits, perishable artifacts, macrobotanical data, or structural remains capable of evidencing the exact nature and timing of prehistoric activities; sites on the mudflats largely consist of lag deposits of artifacts that, because of their size and shape, are more resistant to erosional forces than other items (Carter and Hirschi 2002; also see Davis 1967). Natural processes, especially related to wind, have winnowed out smaller, lighter artifacts and deflated the original surface over millennia. The current study focuses on Paleoarchaic organizational patterns in the project area as indicated by the surface archaeological record. This chapter details the research context for hunter-gatherer research and lithic analysis, and provides research questions based on this information.

GREAT BASIN HUNTER-GATHERERS

Much of what is known about the dynamics of prehistoric hunter-gatherer systems in the Great Basin stems from the early works of Steward (1938), Antevs (1948), and Jennings (1957). According to Steward (1938), native groups used mobility to cope with seasonal and spatial differences in resource availability. Because the Great Basin desert environment can be highly variable in its productivity from year-to-year, inhabitants of the area incorporated flexible land use strategies and social systems to offset potential shortfalls. Small familial units that joined with others to form a larger group to perform certain activities (e.g., pinyon harvest, rabbit drives) represented the most common social groupings. Under this social structure, it was relatively easy to help or be helped by neighboring people as resource availability fluctuated.

In the Great Basin, high elevation mountain ranges receive unpredictable annual precipitation, which, in turn, can favorably or detrimentally affect the resource structure of adjacent basins. These seasonal patterns are also subject to broader climatic trends that occur through time. Antevs (1948) argued that three such trends heavily influenced prehistoric cultures in the region. Named the Anathermal (9,000-7,500 B.P.), Altithermal (7,500-4,000 B.P.), and Medithermal (4,000 B.P.-present), these represent three shifts in Great Basin climate from cool and wet, to hot and dry, and back to cool and wet (although to a lesser degree than before), beginning in the early Holocene. It was Antevs' contention that the paucity of archaeological evidence for human occupation during the Altithermal was a result of the Great Basin becoming an extremely inhospitable place in the lower elevations.

Jennings (1957) "Desert Culture" concept holds that the hunter-gatherer lifeway described by Steward basically remained stable for most of the Great Basin throughout prehistory. Jennings argues, in contrast to Antevs (1948), that the environment changed little as it relates to humans, and that those adaptations that are visible (e.g., bow-and-arrow) did not have significant impacts on overall cultural systems. The Desert Culture is then, according to Jennings, a lifeway necessitated by the marginal environment of the Great Basin. While Great Basin groups may have maintained relatively stable cultural systems at a general level, a wide range of annual and regional variability also existed. Climatic changes have influenced these systems but, as argued by Mehringer (1977), prehistoric peoples could have encountered equal climatic variability within a single year. Mehringer's (1977) contention is a poignant statement about the flexibility of prehistoric land use, but it does not explain the directionality of cultural change over the past 10,000 years (e.g., increased diet breadth, upland occupation, resource intensification).

Elston (1982) argues that population pressure was the primary factor affecting cultural change. For example, early Paleoarchaic groups in the western Great Basin may have abandoned the area as lakes diminished because their adaptive strategies were too specialized to the associated high productivity of these areas, although resources remained abundant compared to later times (Elston 1982:193); later groups had to intensify their subsistence strategies and reoriented themselves toward upland settings, and eventually less optimal locations, because surrounding areas could not absorb them. Climatic shifts influenced both situations, but population levels also played an important role in shaping adaptive changes. New adaptations were to some extent prompted by population density, and at the same time were byproducts of its past influence.

LITHIC TECHNOLOGY

Tool Reduction and Technological Organization

The use of stone for tools requires adjustment of this medium through the kinds of reduction strategies used, tool forms, and the selection of toolstone resources. Lithic reduction itself is indicative of many organizational priorities (Nelson 1991). Reduction strategies are used to impart design elements on stone tools that establish their basic technological roles.

Archaeologists have used the concepts of "curation" and "expediency" (Binford 1973, 1977) to establish the character of prehistoric lithic technology as it relates to future plans for tools, usually imparted on their design. Curation refers to the planned use-life of a tool as long term. Bifaces,

projectile points, and specialized tools are examples of curated tools. Expedient tools are situational in nature, and a large investment in manufacture is not apparent. These opposing design elements were integrated to varying degrees. Expedient reduction strategies can be planned for stone tools if toolstone is available (Nelson 1991:65; Torrence 1983). Nelson (1991:65) uses the term "opportunistic" to describe the lithic reduction in situational contexts. Curation in particular has been criticized as a conflation of numerous design elements that can themselves be contradictory (Bamforth 1986; Hayden et al. 1996; Nash 1996; Odell 1996a). Elements of planned use, multiple uses, transport, maintenance, and recycling can all vary independently from one context to the next (Bamforth 1986).

Other concepts are more specific. Bleed (1986) contrasts "maintainable" and "reliable" systems to embody the design issues important to toolmakers. Maintainable systems are those that are readily available and/or adjustable for a variety of tasks, while reliable systems are usually specialized and feature redundant systems to ensure success when failure would be detrimental. Additional terms provide further delineation. The potential for multiple uses (versatility), the potential for redesign (flexibility), and portability can all be important features to prehistoric people depending on their socio-economic system (Nelson 1991). This vocabulary can be misleading if imposed categorically at the expense of establishing past decision-making contexts. Although lithic technology is meant to systematically cope with variability, technological attributes are dynamic in nature and vary according to the external factors influencing behavior.

Stone Tools and Mobility

All things being equal, mobile hunter-gatherers should possess expedient toolkits since they would then have reduced transport needs. However, toolstone does not cover the earth, and there are countless other factors that require tools to last beyond immediate needs, and therefore, be carried during residential movement. People coped with this variability by using different technological tactics to solve problems of access and scheduling (Binford 1979). Much has been made of Paleoindian technology and land use in this regard. Goodyear (1979) argued that bifaces, by design, are effective transportable items that both conserve raw material and perform multiple functions (also see Kelly 1988). Kelly and Todd (1988) believed that this design complemented the highly mobile lifestyle that allowed immigrant people to populate the Americas. The generalized toolkit was capable of accommodating new problems associated with the unfamiliarity of the terrain and resource distribution. This may explain the earliest organizational incentives, but later Paleoindians surely knew where resources were, and continued a highly mobile lifeway because low population allowed for the exploitation of choice resources across large areas. Folsom groups in the southern Plains possessed a technology that was highly curated because of the scheduling demands and unpredictabilities of following migratory herds of bison across the landscape, while toolstone-quality CCS was available primarily in one area, central Texas' Edwards Plateau (Amick 1996). These design elements changed to greater expediency when Folsom people entered basin and range areas of the Southwest where more toolstone variety was present and resources were found predictably in basins.

Paleoindian technological practices are informative because the spatial scale of their organizational concerns put unique demands on toolstone, but later groups were more restricted in their movements and their technologies reflect this. In the Great Basin, local materials come into

greater use through time. Archaic peoples broadened their diets and intensified their use of smaller resource patches, thereby reducing the demands of toolstone acquisition and tool reliability. Parry and Kelly (1987) argue that the North American trend from biface-oriented to core-flake technologies is indicative of the contrast in logistical demands by mobile versus sedentary settlement systems. Bifaces become less valuable with increased sedentism because material acquisition can be routinely scheduled, and material can be stockpiled at residences. Flake tools can be generated from stored cores when transportation is not as important.

These North American trends illustrate that while there are general patterns through time to prehistoric technology, a solid understanding of resource structure and toolstone availability is necessary for understanding specific cases. One way to investigate this is to see how people equipped themselves with technology for subsistence activities. The Wild Isle area was an extreme point on the landscape, relatively speaking, farther into the Bonneville Basin from solid rock than anywhere around it at the time. This would have required anticipation of technological needs since stone lies outside of a conventional daily round of about 10 km.

Kuhn's (1995:21-29) distinction between *provisioning individuals* and *provisioning places* provides a theoretical reference for technological planning. Provisioning individuals is most effective for mobile peoples. Individuals have to transport the entire technology with every move, and it suits them to have tools that are light, versatile, and made from high-quality material. And with an encounter strategy, the burden of reliable tool use and maintenance is at the individual level. By contrast, provisioning a place makes sense when the nature of activities is known, and to be of some duration. Residential bases become the central decision-making points. It is cost-effective to stockpile lithic resources at these bases, manufacturing tools as necessary to replenish working toolkits. It is the versatile capacity of this stockpile to meet these replenishment demands that is important rather than the versatility of individual tools. Thus, the choices people make with regard to tool design and the type of stone they use should reflect their organizational and functional concerns.

Toolstone Selection

In contrast to the classic Paleoindian pattern of finely-flaked CCS points and tools, which largely comes from the archaeology of the central and eastern United States, Paleoarchaic technology contains substantially more basalt and similar volcanic materials (see Jones et al. 1997; Jones and Beck 1999:95). Basalt is coarser than obsidian and CCS, the primary alternatives. At Wild Isle, basalt and obsidian were the most common materials selected for stone tools. Basalt predominates. In the Great Basin basalt is usually considered the local toolstone, used as necessary between trips to sources of higher quality material during the seasonal round. Archaeologists use the term "local" in the relative sense, compared to exotic obsidian and CCS. But in many cases basalt is not nearby, being no closer than 30 km from Wild Isle, somewhere outside of the Bonneville Basin and a conventional day trip (i.e., 10 km). Since basalt use is usually centered on large tools reduced expediently, such distance would pose a procurement challenge to tool users. Great Basin Paleoarchaic groups are widely thought to have been highly mobile, but if mobile people worked diligently to economize high-quality materials (cf. Goodyear 1979), expedient use suggests a discrepancy.

What discussion has been devoted to Paleoarchaic basalt use only magnifies this discrepancy. Elston (1994) found the preference for basalt at early basalt sites in Whirlwind Valley, north-central Nevada to be especially notable. Basalt use declines substantially by the Archaic, with Tosiwihi CCS, a high quality source located 50 km away, not coming into heavy use until the Late Archaic. Elston (1994:352-353) considers this reliance on basalt curious since it is inferior to CCS and obsidian, but offers its widespread availability and large nodule size as possible reasons for its selection.

Beck and Jones (1990) report a predominance of basalt in early assemblages from Butte Valley, in eastern Nevada. Basalt sources are available 20 to 50 km from the Butte Valley sites, but various CCS sources are available as close as 10 km. The majority of obsidian comes from the Brown's Bench area 200 km to the north. These materials fulfilled different technological roles. Basalt use is argued to replace obsidian projectile points and bifaces locally as they are expended, usually being incorporated into a stemmed point reduction trajectory (Pendleton 1979). Both basalt and CCS are used for some flake tools, but CCS remains the clear choice for most specialized tools or scrapers. There are few CCS bifaces, although there is a lot of CCS biface debitage, indicating that they probably existed as transportable cores for deriving flake tools.

In a later publication, Jones and Beck (1999:90-93) consider the use of basalt with these overall toolstone selection patterns. To the possibility that basalt is a well distributed stone for mobile people, they agree, but note that CCS is also available in many areas. Basalt, however, remains the preferred material for points and bifaces. The use of basalt is then at odds with a highly curated technology. The large points and bifaces may have required basalt's large nodule size, but then similarly sized fluted points in the Great Basin are not made from basalt. Finally, is the possibility that fluted points and stemmed points are different components of the same technology, fluted points falling under the specialized tool forms that required finer-grained materials. There is little chronological data to support this, but Jones and Beck (1999) consider it a possibility.

These researchers admit that a satisfying explanation remains to be found. The relatively poor flaking qualities of basalt compared to the alternatives are not conducive to the biface thinning strategy that would have been important to mobile Paleoarchaic tool users. Basalt is therefore considered a temporary solution to a lack of CCS and obsidian, gradually filling in for points and scrapers as duration of occupation lengthens. With regard to specific tool classes, obsidian is considered valuable for its sharpness, CCS for its durability, and both for their flakability. It is also possible that the CCS common to this region, in contrast to that of the central and eastern United States, varies in brittleness, hardness, and occurrence in ways unfavorable to production of the Paleoarchaic toolkit.

Few redeeming qualities have been offered for the physical properties of basalt. The commonly large size of basalt nodules is one potentially useful quality, and may have been necessary for the artifact types present (Elston 1994). But the contradiction remains that if high-quality CCS was available, mobile people should have made greater use of it. In the central Great Basin, for example, the massive Tosiwihi opalite source was not heavily used until later times (Elston and Raven 1992). Resolution to the issue of basalt reliance may lie in its distribution and size characteristics as they relate to values other than flakability. Flakability may not have been a priority, and if so, then other economic variables related to technology must be considered.

Lithic Economy and Toolstone Quality

At least since the 1970s, lithic analysis has been oriented toward economic explanations for technological patterning. These sometimes take the form of common sense arguments, but a trend continues to develop toward greater explication of the variables involved and how they mediate risk (Bamforth and Bleed 1997; Elston 1986, 1990, 1992; Ericson and Purdy 1984; Johnson and Morrow 1987; Kuhn 1994; Odell 1996b; Torrence 1989). More detailed studies allow specific components to be thoroughly understood and enable lithic analyses to be better integrated and modeled with similar work in optimal foraging theory and evolutionary ecology (cf. Bettinger 1991; Earle 1980; Keene 1983; Kelly 1995; Smith and Winterhalder 1992; Winterhalder and Smith 1981). This perspective views lithic technology as an adaptive system that will reflect energetically cost-effective decision-making on the part of tool users. Sometimes people saved energy by economizing toolstone, sometimes they did not. Elaborate modeling is beyond the scope of this report, but it is possible to provide a general orientation of what questions should be asked. The source of basalt is not known, but must minimally be 30 km away, and the same is true for CCS. Obsidian at Wild Isle comes from between 80 and 200 km away. The physical qualities of these materials are likely to provide different incentives for their use.

There is no clear reason to prefer basalt over obsidian or CCS based on inherent physical properties. Compared to these materials, basalt is: (1) *Intractable*. The crystalline structure of basalt makes flaking less predictable and controllable. Combined with its brittleness, biface reduction results in more fatal snaps and end shock breaks. It is also a dense and tough material to flake, requiring that it be struck hard, without the corresponding elasticity of CCS. (2) *Dull*. Its coarseness means that it is less suitable for tasks that require an exceedingly sharp working edge. (3) *Soft*. Basalt is slightly softer than CCS and obsidian. Compounding this problem, if increased pressure is applied to compensate for its lack of sharpness, dulling likewise quickens. Alternately, if used for low-pressure tasks basalt's dense nature makes it an otherwise durable material.

These variables obviously apply to tool use efficiency, but they also have implications for other organizational and functional issues. When homogeneous CCS is used for bifaces, they are sharp, durable, elastic, resistant to breakage, easily reshaped for different tasks, and easily resharpened with little waste. This is important if tools need to last or be refined. Obsidian is less durable and more brittle, but can be used similarly. Basalt is more widely distributed in more accessible forms than obsidian and CCS, but with regard to functionality, it is again of questionable value compared to these alternatives.

As previously described, it has been demonstrated in the Great Basin that Paleoarchaic people used different toolstones for different tool types (Beck and Jones 1990). Basalt has been shown to replace CCS and obsidian items at a local level. The use of basalt would remain effective for the procurement of plants and more detrimental for animal butchering purposes, although capable of both. Basalt use wear studies bear this out (see Richards 1988). It appears that recognizing the functional requirements of the Paleoarchaic toolkit is crucial to understanding the use of basalt.

RESEARCH QUESTIONS

The following research questions are designed to examine Paleoarchaic behavior in the project area, and by extension, the greater Wild Isle area. These questions fall under primary research domains, but emphasis is placed on how relationships that can be tested with lithic data.

1) Can residential sites be distinguished from task-oriented sites?

Residences are expected in the greater Wild Isle area since there are no otherwise distinctive areas for habitation located nearby. Residences should contain evidence of both tool manufacture and tool use related activities to be performed onsite and at task-specific sites. For example, both production-level and expended bifaces should occur at residences. Diverse artifact types encompassing the entire lithic toolkit (i.e., projectile points, bifaces, flake tools, ground stone) should be present representing the more diverse activities that take place at these sites. Residential sites are expected to be larger as a result of these activities. They would also be expected on the highest ground available on this generally level landscape. Where ground stone is present, it is expected at residences.

Task-oriented sites should contain only task-specific artifacts. It is not known exactly how the different components of the Paleoarchaic toolkit were used, but in general, stone tools should be expended rather than manufactured at these locations. This pattern would be evidenced in bifaces by expended items of diminutive size in comparison to those at the production-level. Debitage should represent tool maintenance (e.g., small biface resharpening) rather than manufacture (e.g., large biface reduction). Differences between residential and task-oriented sites are expected to be subtle, presuming that Paleoarchaic groups moved frequently.

2) Did people intend to use the area for short or long durations?

Mobile peoples are expected to possess transportable technologies that minimize waste of toolstone and allow them to move quickly in and out of areas. Design elements of such technologies would include the use of carefully flaked bifaces made from high-quality material to extend tool use lives and versatility. Attributes indicative of the original flake blank from which bifaces were made should occur infrequently, items exhibiting morphological symmetry in cross-section and long flake scars that extend across the center of the artifact (i.e., biface thinning). Bifaces should double as tools and cores, their use as cores being evident in the form of flake tools made from biface reduction flakes. Exotic toolstone should predominate since the high-quality material necessary to meet design demands is not present locally. These predictions are consistent with the concept of provisioning mobile individuals with long-distance annual settlement rounds.

Long-term activities would draw from local materials more frequently. A greater tendency to rely on stockpiled material, be they large block cores, flake blanks, or bifacial cores, would reflect the provisioning of a place. Because they are presumably closer to the Wild Isle/South Route area, basalt and similar materials are expected from people with long-term interests. Basalt tools would be expected across all tool classes, replacing the CCS and obsidian items transported into the area. Biface flaking techniques should be less refined if items were replaced as necessary from stockpiles. This should especially be the case with basalt because of the increased breakage risks associated with using thinning as a reduction strategy. The detachment scar from the

original flake blank should often be visible on one face and this evidence should occur in similar proportions throughout the size range. This is indicative of the selection of appropriately-sized flake blanks for different size requirements rather than the continuous reduction of a single biface to meet changing functional demands. Moreover, the tool should retain morphological attributes of the original blank in cross-section. Flake tools would infrequently be generated from biface reduction flakes, with the possible exception of the largest bifaces, more commonly being produced separately at quarries or stockpiles.

3) *Is lithic technology designed more toward plants and small game or large migratory animals?*

This question is designed to relate South Route data to the basic issue of how much Paleoarchaic peoples resembled later Great Basin hunter-gatherers. Use wear evidence is the best way to answer this question, but based on previous inventories, artifacts were expected to be too weathered to exhibit edge wear attributes. However, tool design and toolstone selection can also be indicators of prehistoric use intentions.

A technology centered on large migratory game should be reliable, transportable, sharp, and in general, much like that described for highly mobile people. It should utilize high-grade materials to fulfill these requirements. The hunting orientation should be reflected in a high ratio of projectile points to other stone tool types. Bifaces may be capable of serving as tools themselves and as cores from which sharp butchering tools can be derived.

It is expected that plant-oriented flaked stone technology should maximize durability, maintainability, and flexibility (i.e., functionality) over reliability (i.e., refinement). If stone tools were used in the mass collection of high-ranking plant parts the need for highly specialized and/or exceedingly sharp tools would be minimized. Lower-grade materials such as basalt would be expected if locally available. Crude, generalized tool forms would be expected for conducting these tasks, regardless of material type, although more formal design elements (as discussed with the previous question) may countervail such minimal reduction strategies in cases of high residential mobility. Again, remnant blank attributes should occur on tools. The ratio of projectile points to other tool classes should be low. Like plants, small terrestrial animals, fish, and waterfowl are captured in restricted, if not fixed, locations, and therefore technological similarity is expected; however, the need for sharp working edges may be greater putting increased emphasis on fine-grained material such as obsidian.

4) *Could lithic materials have been traded into the project area?*

It is not likely that this question can be answered directly, but data on tool types and duration of occupation can relate to the likelihood of trade. If long-term stays were taking place then the presence of exotic toolstone may be best explained by trade, but if people were highly mobile it is likely that they directly procured these lithic materials. Obsidian sourcing was not possible on this project, but it is assumed that obsidian collected on the South Route should be from the same sources as items from Wild Isle and Wildcat Mountain sites. These data indicate that obsidian sources between 80 km and 200 km away were relied heavily upon. The goal of asking this question is to relate this case study to current ideas about the potential for Paleoarchaic trade.

5) *When did activities take place?*

Organic data, such as charcoal, faunal remains, and macrobotanical remains are required to give accurate dates for activities. These were not expected on the South Route, and the question is meant to clarify the extent to which the archaeology of the mudflats reflects Paleoarchaic activity versus later time periods. Primary data are WST projectile points. Later projectile point styles would be indicators of later occupations.

CHAPTER 5 METHODS

FIELD METHODS

The pedestrian survey methods employed during this project consisted of two people covering the 400 ft (122 m) South Route corridor in 30 m transect intervals. These methods are consistent with those used on previous inventories on UTTR. Ground visibility was 95 percent or greater across the entire route, with only occasional pickleweed plants providing coverage. The black basalt and obsidian artifacts starkly contrasted with the desert surface.

All locational information was recorded using a handheld Magellen® Global Positioning System (GPS) 320. This was done both for sites and isolated finds. Site datums were re-recorded by the Hill AFB Geographical Information System (GIS) specialist at a later date with another GPS unit to cross-check accuracy. These readings ensured sub-meter accuracy for site locations. Site datums were marked with wooden stakes.

When an artifact was encountered, the surrounding surface was examined to determine whether additional artifacts were present. If the artifact(s) was an isolate, it was recorded as such in a numbered sequence. To be consistent with previous surveys at Wild Isle (Carter 1999; Carter and Young 2002), isolates were defined as less than five items within a 100-m² (10-x-10-m) area; sites were assigned a field number (e.g., GMI 01-1) when five or more artifacts were present. When sites were encountered, all artifacts were marked using pin flags. Site boundaries were then mapped based on the distribution of artifacts using a compass-and-pace method. Information necessary for completion of the Intermountain Antiquities Computer System (IMACS) site forms was collected. Previous surveys and monitoring at Wild Isle (Carter 1999; Carter and Young 2002; Duke 2002) found that Paleoarchaic sites in the area are situated on deflated surfaces, and therefore, shovel probes were not used on this inventory.

All stone tools found in sites or as isolates were collected for further analysis in the laboratory. Debitage was recorded and left in the field. Hill AFB has a collection policy for diagnostic artifacts. For lithic scatters, this minimally includes temporally diagnostic projectile points. Since the greater Wild Isle area is unique for its Paleoarchaic record, and use of the South Route could potentially destroy these artifacts, all stone tools were collected. This includes projectile points, bifaces, flake tools, and ground stone.

A photographic record was maintained of each site. Digital photographs as well as 35 mm color and black-and-white prints were taken at each site. Detailed photo logs were kept to document the subject of the pictures.

LABORATORY ANALYSIS

One hundred percent of the artifacts from the South Route inventory were analyzed. Debitage was recorded in the field on field forms. Flaked stone tools and ground stone attributes were recorded in the laboratory and the information stored in a Microsoft® Access database. Since all of the sites identified were sparse, no special loci distinctions or sampling strategies were required. Each collected artifact was given a catalog number in a manner consistent with previous surveys at Wild Isle (Carter and Young 2002:71). Artifacts were placed in 2-mil bags along with acid-free archival paper tags possessing provenience and catalog information. The plastic bag was labeled with the artifact's catalog number in permanent marker. All artifacts, forms, photographs, and field notes will be turned into the Hill AFB cultural resources manager for curation.

Smithsonian trinomial numbers for sites were requested from the Archaeological Records Manager at the Antiquities Section of the Utah Division of State History. These numbers replaced the previously assigned GMI field numbers.

Stone Tool Analysis

This section details the methods of analysis for different artifact classes. Several attributes were recorded across classes to provide standard data for regional comparison. Size measurements of length, width, and thickness were measured to the nearest millimeter using vernier calipers. Weight was measured to the nearest 0.25 gram using a Pesola® 30 g spring scale. Material type and cortex presence/absence were also recorded for all lithic artifacts. Additional attributes were recorded that specifically pertain to research questions. These are discussed by artifact type.

Flaked Stone Tools

Flaked stone tools were first separated by tool type. These types consist of bifaces, projectile points, and flake tools. In addition to the attributes mentioned above, breakage and blank evidence were recorded for each of these artifact types. Breakage was defined as lateral snap, perverse, impact, or radial. Blank evidence refers to attributes indicating that a tool was reduced from a flake blank, and consists of remnant blank surface, longitudinal curve, and plano-convex cross-section.

Bifaces were classified as *roughout*, *rough percussion*, *fine percussion*, *rough pressure*, or *fine pressure*. These terms are modified from the Gatecliff Shelter analysis of Thomas and Bierwirth (1983:212-221). The modifications made are in nomenclature. The terms "blank" or "knife" are excluded from several categories to reduce any presumptive assignment of toolmaker intent. Width/thickness ratio was calculated as a measure of biface thinness.

Projectile points were classified according to style and stemmed points were noted as *Western Stemmed Tradition (WST)* with further delineation by type consistent with Carter (1999). An assessment of artifact rejuvenation was also made, and points were noted as beveled, scavenged, and reworked.

Edge modified flakes were divided into two types, *formed flake tools* and *edge damaged flakes*. Formed flake tools exhibit evidence of edge modification through intentional reduction, while edge damaged flakes exhibit incidental damage that may result from use or natural processes (e.g., trampling, turbation). Archaeological and natural context-specific conditions often are the deciding factors in interpretation of edge damaged flakes as flake tools or naturally-damaged debitage. Modification on all flakes was noted as bifacial or unifacial.

Core analysis included recording the number of platforms each core exhibited, and whether the core was fragmented or expended. Core fragments possess portions of platforms, and occasionally represent platform removal flakes possessing an interior surface and bulb of percussion. Expended cores possess entire platform areas, show large flake scars relative to the remaining core size, and/or awkward reduction angles relative to the core size that do not permit further productive reduction.

Debitage

Debitage analysis was recorded on field forms since this material was not collected. Flakes were identified using two classification keys, one for basalt and one for obsidian and CCS (these materials were not tallied together on the same form, just classified similarly). Field forms are located in Appendix A. Generic flake types consist of core reduction, biface reduction, pressure, retouch/edge preparation, shatter, and indeterminate. These types are defined differently on the two forms. Obsidian and CCS debitage was classified in a common manner, with biface and core reduction flakes separated by the presence or absence of platform faceting, respectively. Additionally, distal flake portions could be defined as biface reduction flakes if they possessed both longitudinal curvature and low arrises. Early and late stage designations are made according to number of exterior scars; three or less exterior scars represent the early stage, and greater than three represents late stage. Indeterminate flakes are the broken medial and/or distal fragments of flakes. Shatter is blocky debris possessing no orientable surface. Pressure and retouch/edge preparation flakes are both less than 1/4" in size, but pressure flakes are differentiated by a small, ground platform. Size (1/8-1/4", 1/4-1/2", 1/2-1", 1-2") and cortex (presence or absence) were also recorded. Other attributes were recorded when present (e.g., heat damage, patina, calcium carbonate deposits).

Basalt debitage was classified differently, based on experiments previously conducted by the author (Duke et al. 1998). Basalt biface reduction flakes often possess planar platforms (these can usually be seen as concave on close inspection) as a result of the true platforms having detached when removed. A false platform remains that resembles that of a core reduction flake. The rough nature of most basalt biface reduction only adds to this misrepresentation. Biface reduction flakes can be wedge-shaped rather than long and curved, and arrises can be high and distinctive. The difference between core and biface reduction flakes is defined then by exterior platform angle. Core reduction flakes possess an exterior platform angle of greater than 75 degrees, and biface reduction flakes are defined by an exterior platform angle of less than 75 degrees. Other criteria are the same as those for CCS and obsidian.

Ground stone

Ground stone data categories consist of artifact type, raw material, shape, size, and working surface use wear. Dimensions of length, width, and thickness were measured to the nearest millimeter.

CHAPTER 6

INVENTORY FINDINGS

The South Route inventory resulted in a total of nine prehistoric archaeological sites and 39 isolates, isolates sometimes containing more than one item. Western Stemmed series projectile points were the only point style observed on the survey, and all other material appears to be Paleoarchaic in nature. With the exception of two pieces of ground stone, artifacts consisted of flaked stone tools and debitage. These are made primarily from basalt and obsidian, with only a few CCS items. This chapter describes the materials found and summarizes their patterning.

ISOLATED ARTIFACTS

Isolated artifacts occurred across much of the route, but most frequently along its east-west portion. These artifacts consist of nine bifaces, seven Western Stemmed points, three flake tools, one Haskett biface (Figure 6, 0.39.0), and 43 flakes. Tools were collected and their attributes are presented in the artifact catalog in Appendix B. Flakes were recorded in the field and are detailed in Table 4.

The Haskett biface/point is notable because it is the only such style observed on the South Route, and none were reported from previous surveys on Wild Isle (Carter 1999; Carter and Young 2002) or near Wildcat Mountain (Arkush and Pitblado 2000). This artifact actually consists of two broken pieces—a base and medial section—found side-by-side. The basal margins are ground.

Isolate debitage consists almost completely of basalt (n=42), with only one piece of obsidian. When these flakes are identifiable by type they are usually biface reduction flakes. Basalt debitage is most commonly ¼-in to 1-in in size. No cortex is present on any of the debitage.

ARCHAEOLOGICAL SITES

South Route sites, all sparse surface lithic scatters, were found in two different settings: (1) mudflat areas with paleochannel levee remnants and coppice dunes formed in the alternating swales and anchored by pickleweed (Figure 7), and (2) barren mudflat areas, sometimes

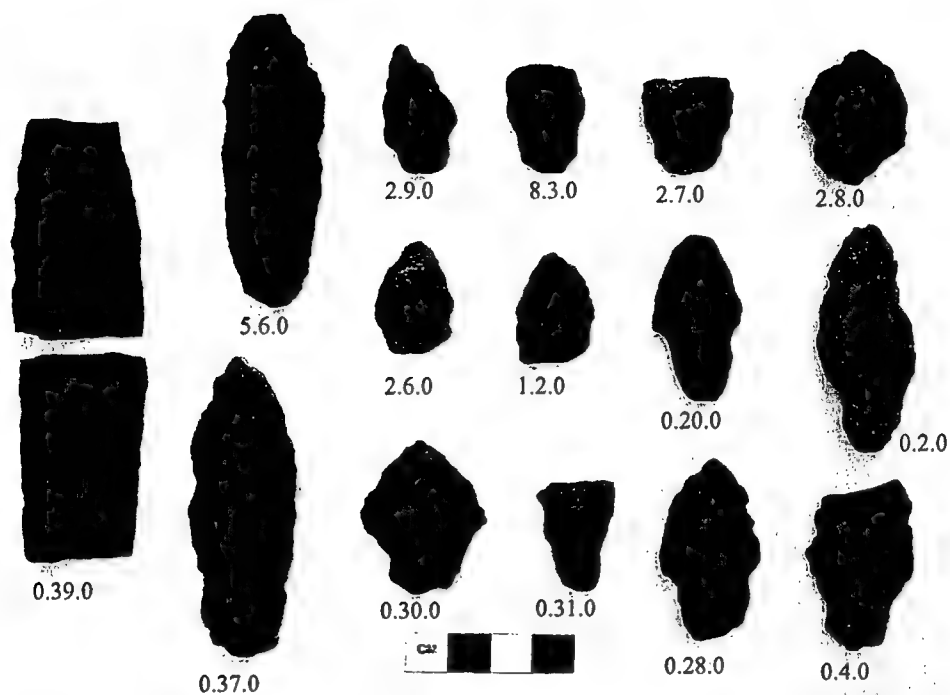


Figure 6. Projectile points collected on the South Route inventory.

Table 4
Debitage Recorded as Isolated Finds

	$\frac{1}{8}$ – $\frac{1}{4}$ "	$\frac{1}{4}$ – $\frac{1}{2}$ "	$\frac{1}{2}$ –1"	1–2"	>2"	Totals
Basalt						
Core Reduction		1	1	3		5
Biface Reduction		3	1	1	2	7
Indeterminate	1	13	11	4		29
Shatter		1				1
Totals	1	18	13	8	2	42
Obsidian						
Indeterminate			1			1
Totals			1			1



Figure 7. Overview looking toward Wildcat Mountain and the Cedar Mountains of site 42TO1868 showing alternating coppice dunes and paleochannels. Paleochannels are identifiable by the whitish color.

suggestive of slight topographic depressions (Figure 8). There is depositional patterning that correlates with these distinctions. Most sites represent prehistoric activities, but several sites appear to be the product of artifact redeposition through natural processes.

42TO1863

Site Type: surface lithic scatter

Location: UTM 285618 E 4476369 N

Elevation: 4232 ft

Size: 3,689 m²

Vegetation: pickleweed (*Allenrolfea occidentalis*)

Artifact Numbers: 1.1.0 to 1.10.0

Site 42TO1863 is a sparse lithic scatter situated on the mudflats immediately west of the Wild Isle dune field. A site map is presented in Figure 9. The site sits on the mudflat surface, and is criss-crossed by paleochannels of the Old River drainage system which rise up to 10 cm above the playa surface. Artifacts exhibit extensive weathering.

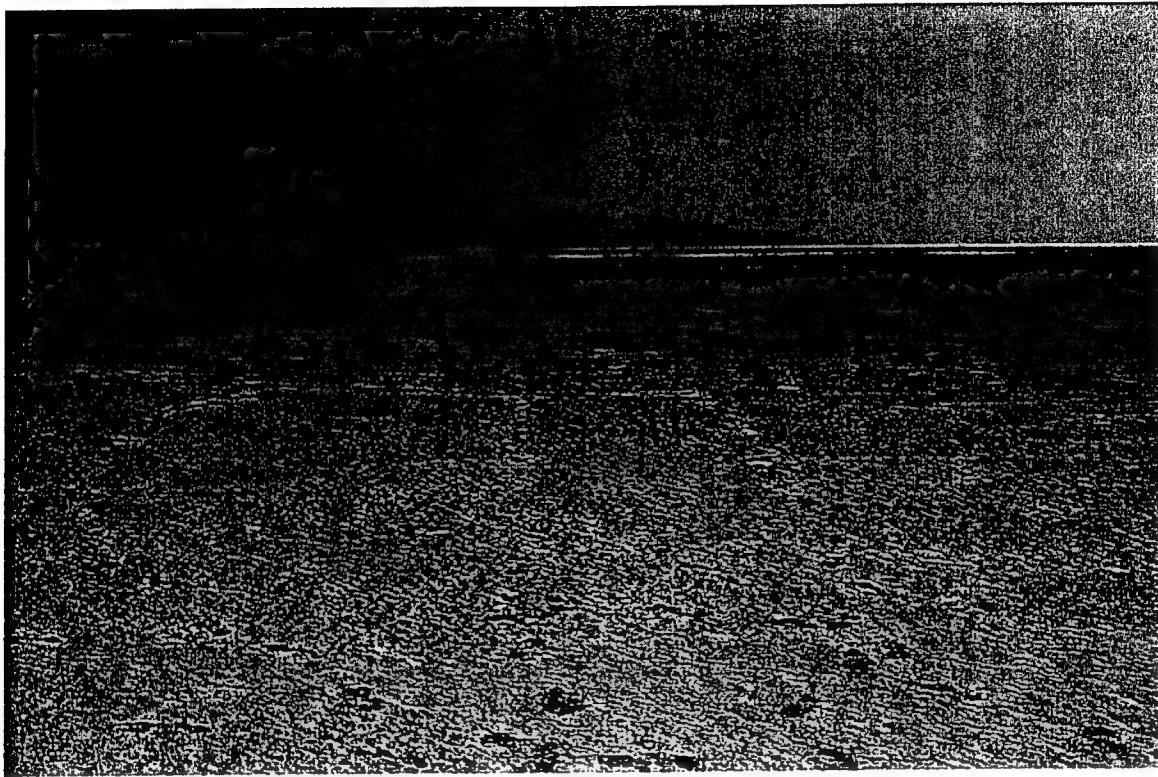


Figure 8. Overview looking toward Granite Peak of site 42TO1871 showing barren mud flat context.

Stone tools from the sites consist of one Western Stemmed point, one roughout biface, and six flake tools (Figure 10; also see Figure 6). The flake tools consists of three formed flake tools and three edge damaged flakes. With the exception of the stemmed point made from obsidian (1.2.0), these are made from basalt. Basalt also predominates in the debitage assemblage (Table 5) accounting for 93 percent (n=28) of flakes. Two flakes are made from obsidian. One obsidian flake (1.9.0) and two basalt flake tools (1.3.0, 1.5.0) possess cortex. These artifacts combined with the small spatial extent of the site suggest short-term, task-specific activities. There is no potential for intact deposits as the artifacts are situated on a deflated surface.

42TO1864

Site Type: surface lithic scatter

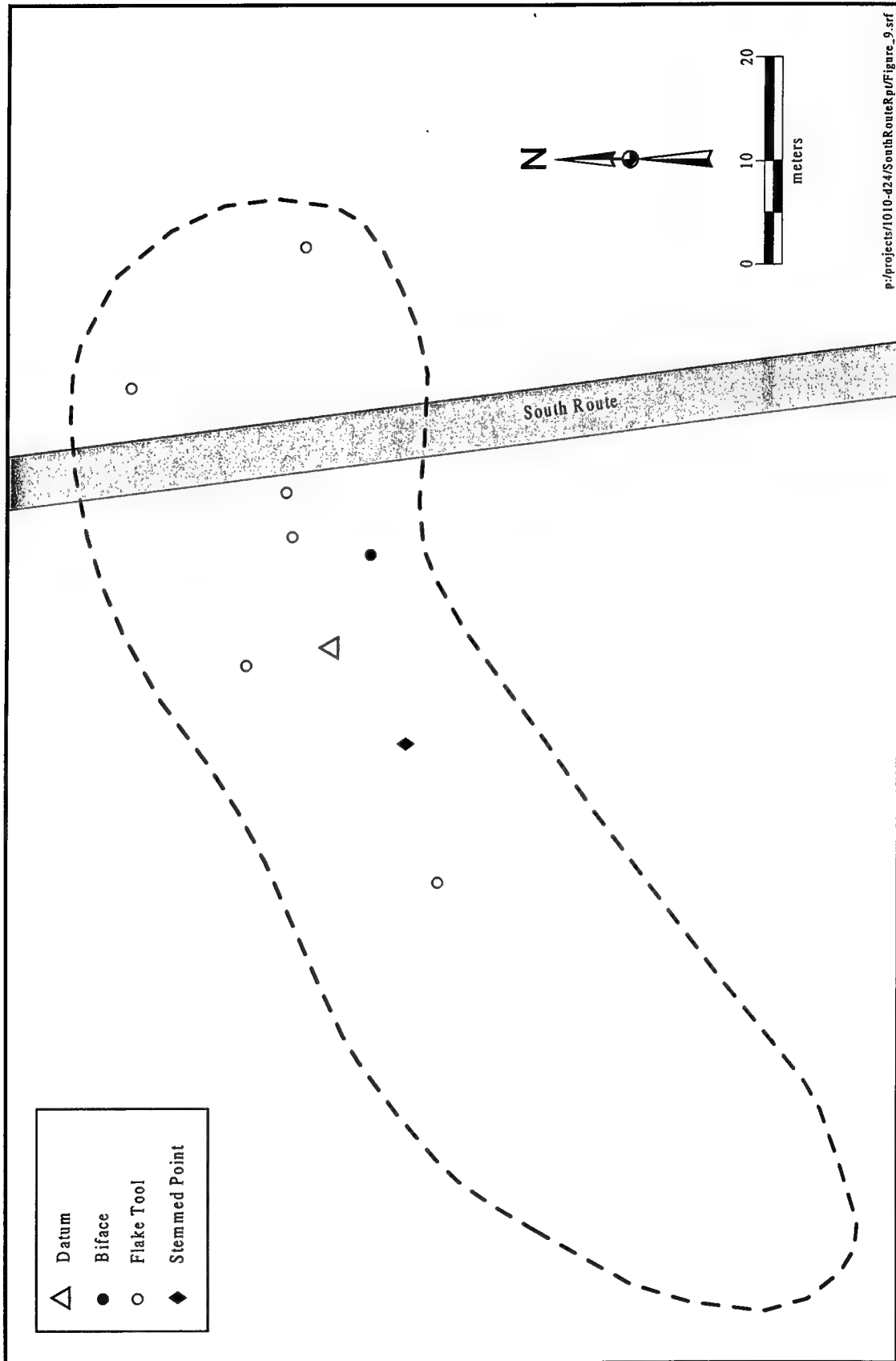
Location: UTM 286749 E 4469674 N

Elevation: 4234 ft

Size: 804 m²

Vegetation: pickleweed (*Allenrolfea occidentalis*)

Artifact Numbers: 2.1.0 to 2.9.0



p:/projects/1010-424/SouthRouteRpt/figure_9.srf

Figure 9. Plan map of site 42TO1863.

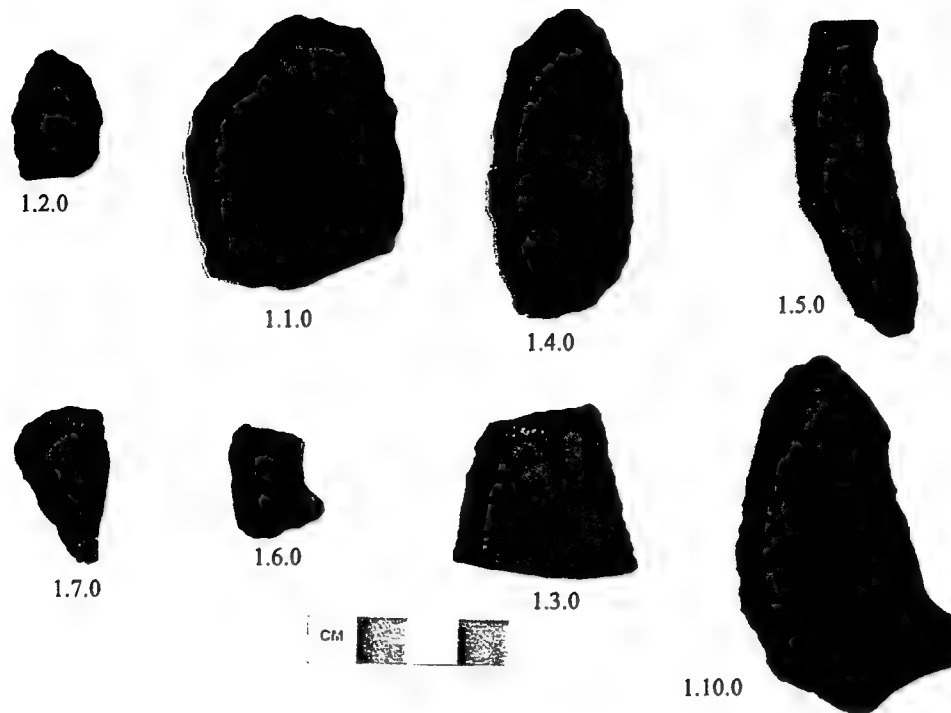


Figure 10. Stone tools from site 42TO1863.

Table 5
Debitage Recorded at Site 42TO1863

	$\frac{1}{8}$ - $\frac{1}{4}$ "	$\frac{1}{4}$ - $\frac{1}{2}$ "	$\frac{1}{2}$ -1"	1-2"	>2"	Totals
Basalt						
Core Reduction		1	2			3
Biface Reduction			8	1		9
Indeterminate		5	8	2		15
Shatter			1			1
Totals		6	19	3		28
Obsidian						
Biface Reduction			1			1
Shatter				1		1
Totals			1	1		2

Site 42TO1864 is a sparse lithic scatter situated on the mudflats west of the Wild Isle dune field. A site map is presented in Figure 11. The site sits on the mudflat surface. Remnant paleochannels exist nearby, but are not present on-site. Artifacts exhibit extensive weathering.

Stone tools from the sites consist of four Western Stemmed points and five bifaces (Figure 12; also see points in Figure 6). The bifaces consist of three rough percussion and two roughouts. One stemmed point is made from obsidian (2.9.0), the other tools are made from basalt. The entire debitage assemblage consists of basalt (Table 6), none possessing cortex. These artifacts combined with the small spatial extent of the site suggest short-term, task-specific activities. There is no potential for intact deposits as the artifacts are situated on a deflated surface.

42TO1865

Site Type: surface lithic scatter
Location: UTM 288742 E 4469061 N
Elevation: 4237 ft
Size: 316 m²
Vegetation: none
Artifact Numbers: 3.1.0-3.2.0

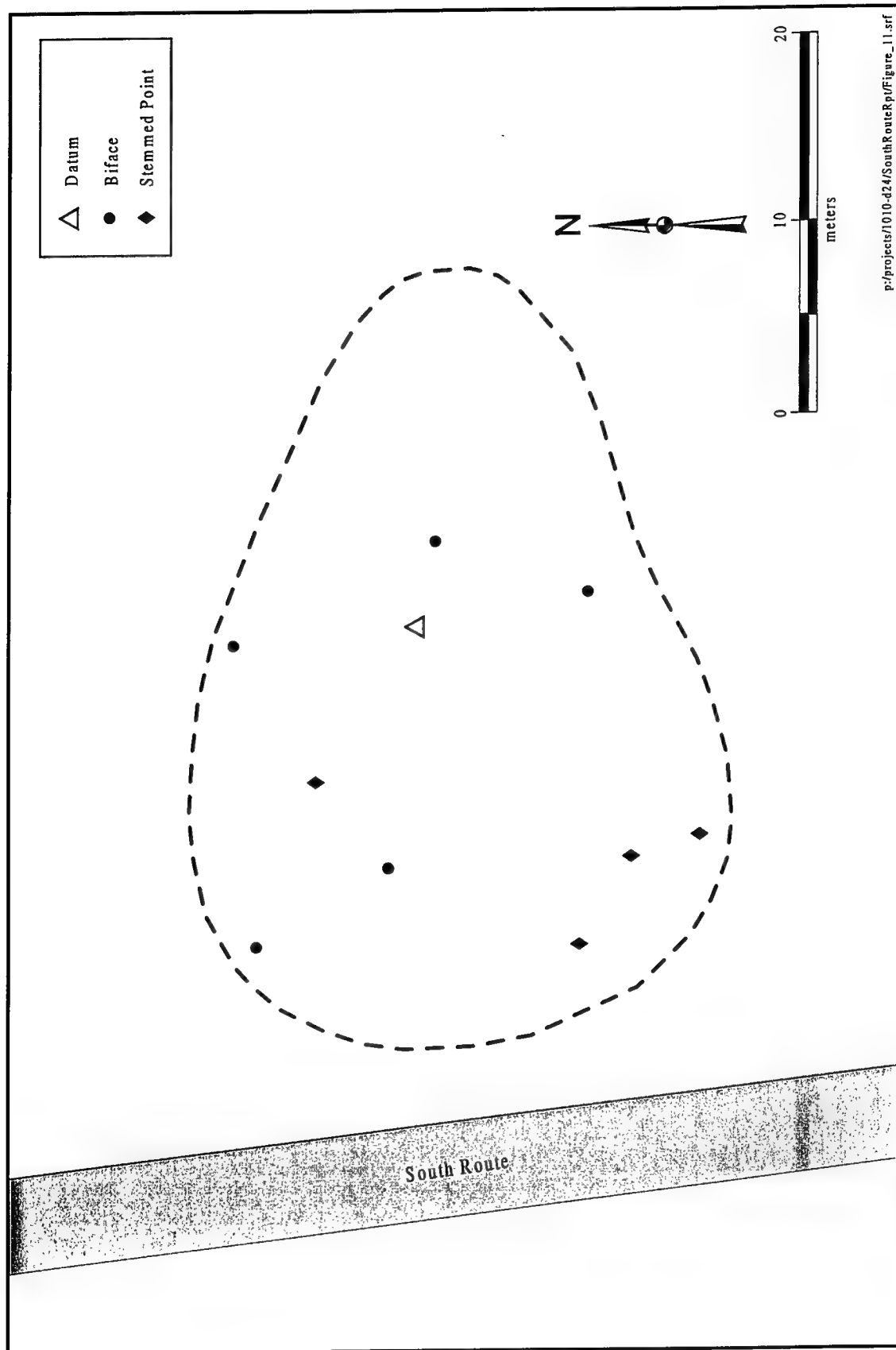
Site 42TO1865 is a sparse lithic scatter situated on the mudflats immediately south of the Wild Isle dune field. A site map is presented in Figure 13. The site sits on barren mudflat surface with no vegetation. No paleochannels are present. Artifacts exhibit extensive weathering.

Stone tools from the site consist of two bifaces, both made from basalt (Figure 14). Three basalt flakes were also recorded (Table 7); these do not possess cortex. These artifacts combined with the small spatial extent of the site suggest short-term, task-specific activities. There is no potential for intact deposits as the artifacts are situated on a deflated surface.

42TO1866

Site Type: surface lithic scatter
Location: UTM 296141 E 4468669 N
Elevation: 4252 ft
Size: 341 m²
Vegetation: pickleweed (*Allenrolfea occidentalis*)
Artifact Numbers: 4.1.0

Site 42TO1866 is a sparse lithic scatter situated on the mudflats 9.3 km southeast of the Wild Isle dune field. A site map is presented in Figure 15. The site sits on the mudflat surface, and is criss-crossed by paleochannels of the Old River drainage system which rise up to 10 cm above the playa surface. Artifacts exhibit extensive weathering.



p:/projects/1010-424/SouthRouteRpt/Figure_11.srf

Figure 11. Plan map of site 42TO1864.

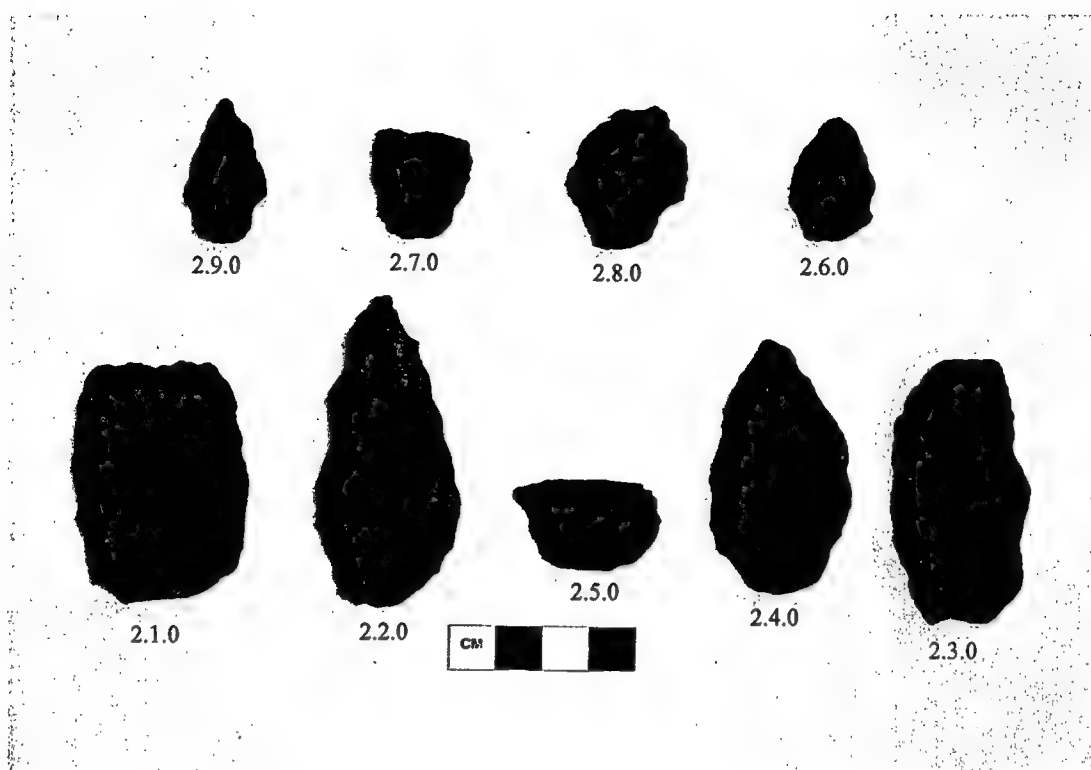


Figure 12. Stone tools from site 42TO1864.

Table 6
Debitage Recorded at Site 42TO1864

	$\frac{1}{8}$ - $\frac{1}{4}$ "	$\frac{1}{4}$ - $\frac{1}{2}$ "	$\frac{1}{2}$ -1"	1-2"	>2"	Totals
Basalt						
Core Reduction				2		2
Biface Reduction				1		1
Indeterminate				2		2
<i>Totals</i>				5		5

Stone tools from the sites consist of one rough pressure biface made from obsidian (Figure 16). Seven pieces ofdebitage were recorded on the site (Table 8). All but one flake are made from basalt. One obsidian core reduction flake is also present. None of thedebitage possesses cortex. These artifacts combined with the small spatial extent of the site suggest short-term, task-specific activities. There is no potential for intact deposits as the artifacts are situated on a deflated surface.

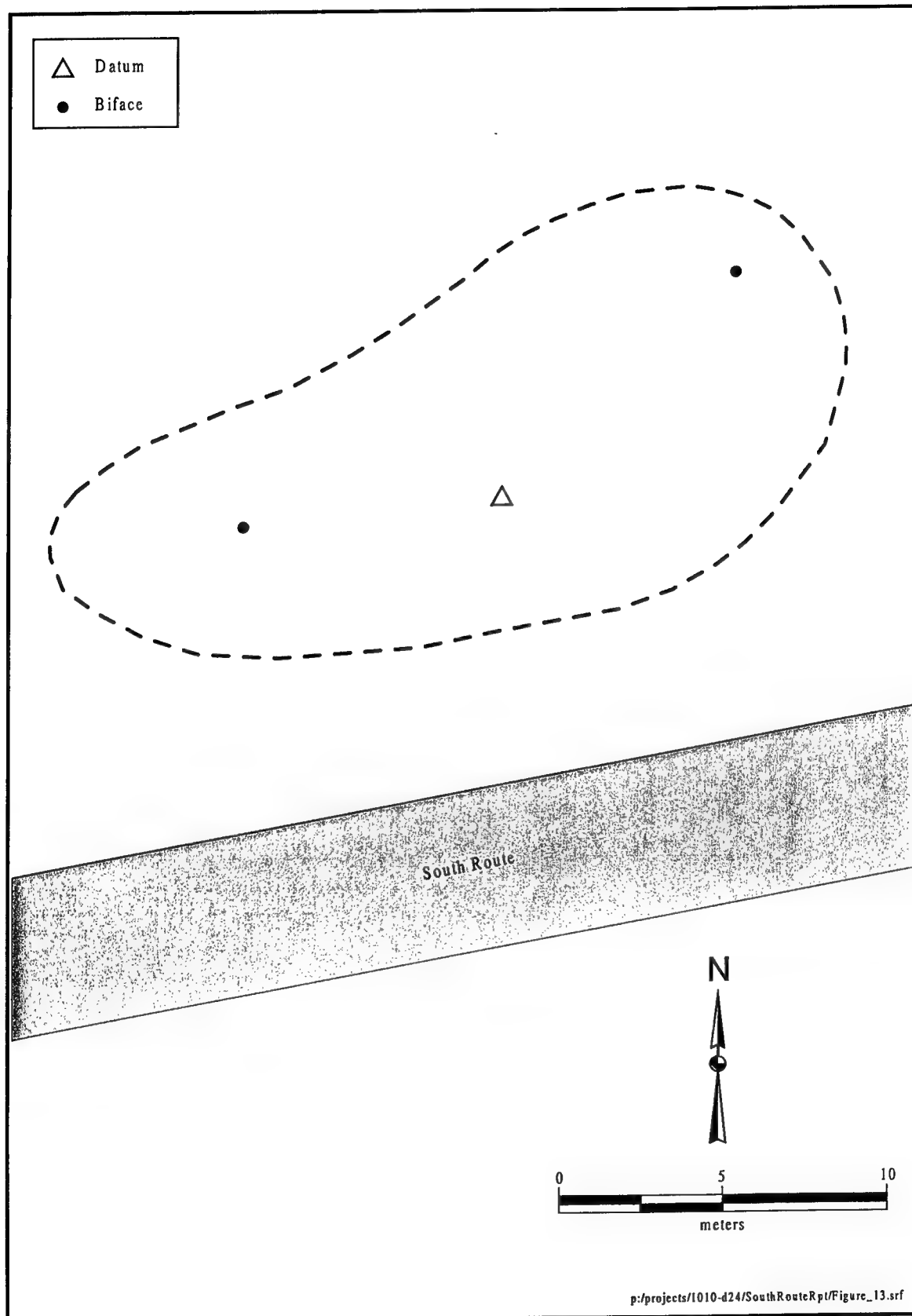


Figure 13. Plan map of site 42TO1865.

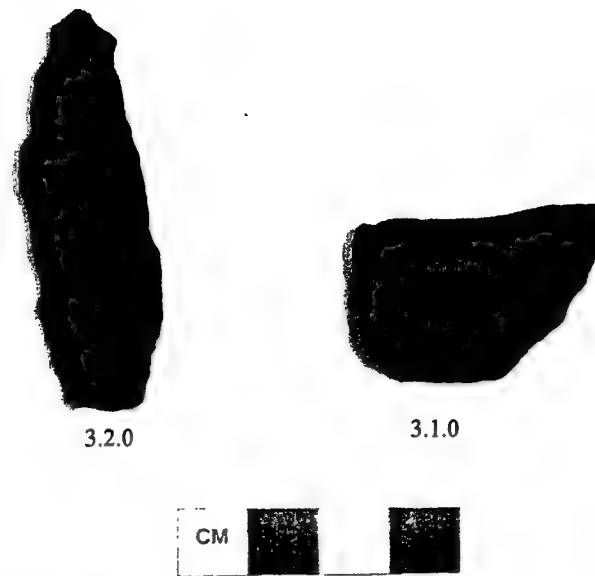


Figure 14. Stone tools from site 42TO1865.

Table 7
Debitage Recorded at Site 42TO1865

	$\frac{1}{8}$ - $\frac{1}{4}$ "	$\frac{1}{4}$ - $\frac{1}{2}$ "	$\frac{1}{2}$ -1"	1-2"	>2"	Totals
Basalt						
Biface Reduction			1	1		2
Indeterminate					1	1
<i>Totals</i>			1	1	1	3

42TO1867

Site Type: surface lithic scatter

Location: UTM 294998 E 4468696 N

Elevation: 4248 ft

Size: 7,715 m²

Vegetation: pickleweed (*Allenrolfea occidentalis*)

Artifact Numbers: 5.1.0-5.8.0

Site 42TO1867 is a sparse lithic scatter situated on the mudflats 8.6 km southeast of the Wild Isle dune field. A site map is presented in Figure 17. The site sits on the mudflat surface, and is criss-crossed by paleochannels which rise up to 20 cm above the playa surface. Some of these channels are filled with coarse to peas-size gravels which may relate to pre-Gilbert flow of the Old River near its termination. These form a slightly more rugged and higher topographic setting than surrounding mudflats. Gravel channels have not been observed at Wild Isle, less than 10 km to the northwest. Artifacts exhibit less weathering than those at other sites, indicating that they may have been protected by dunes longer than those other in other areas of the mudflats.

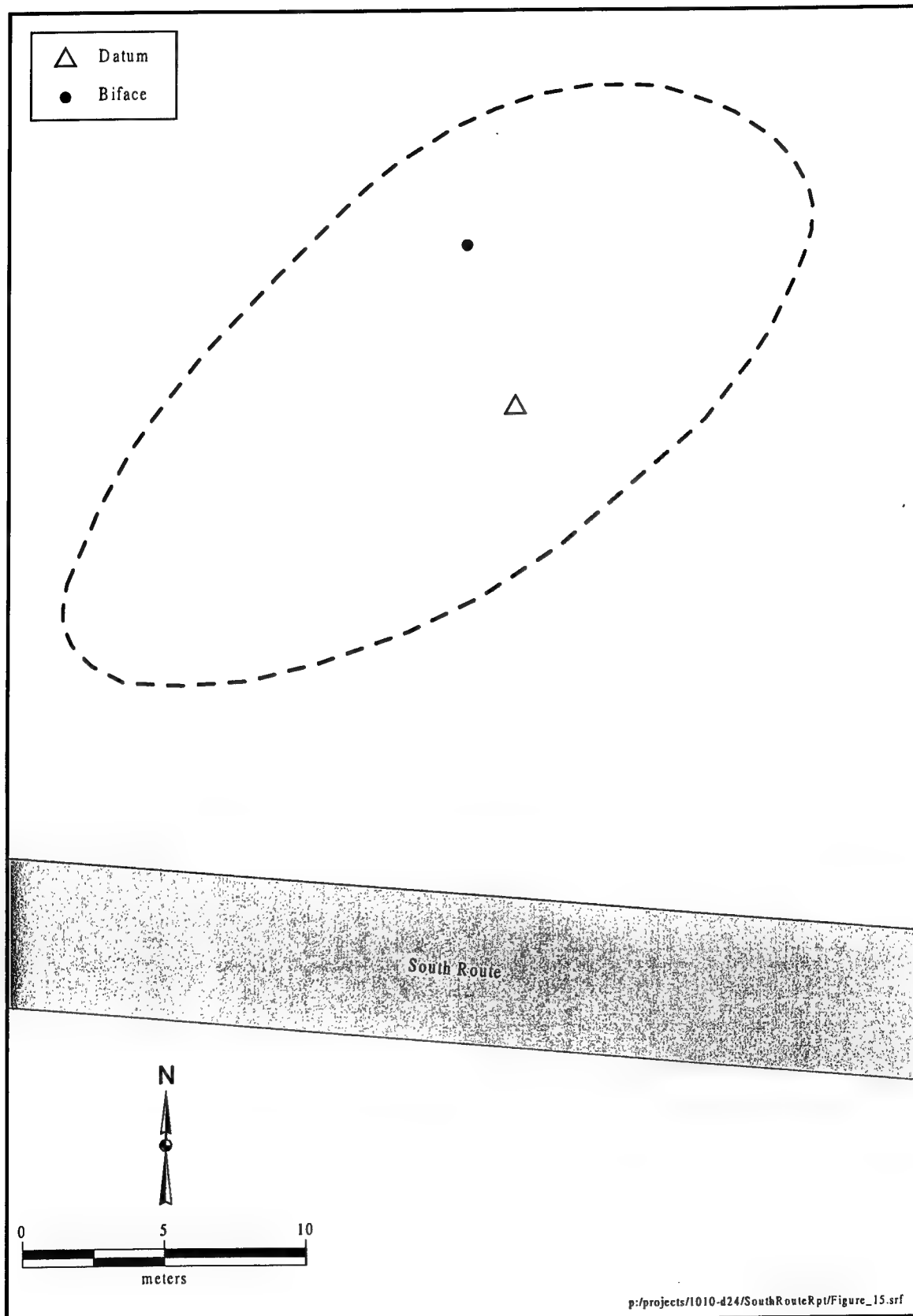


Figure 15. Plan map of site 42TO1866.

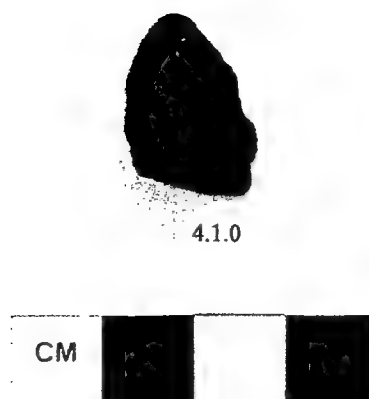
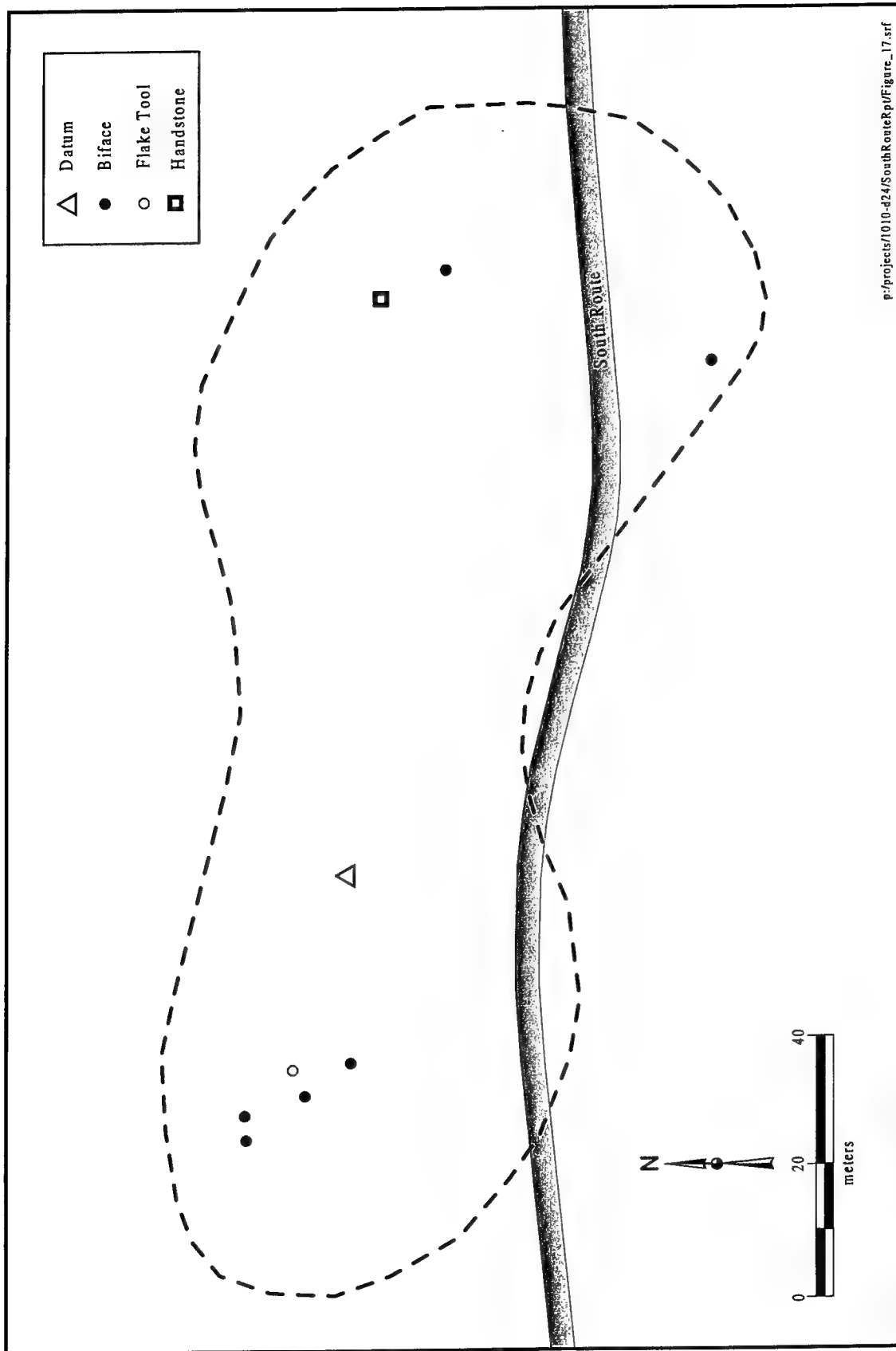


Figure 16. Stone tool from site 42TO1866.

Table 8
Debitage Recorded at Site 42TO1866

	$\frac{1}{8}$ - $\frac{1}{4}$ "	$\frac{1}{4}$ - $\frac{1}{2}$ "	$\frac{1}{2}$ -1"	1-2"	>2"	Totals
Basalt						
Core Reduction			1			1
Biface Reduction			1			1
Indeterminate	1	2				3
Totals	1	2	2			5
Obsidian						
Core Reduction			1			1
Totals			1			1

Stone tools from the sites consist of five bifaces (five rough percussion), one WST point, one flake tool, and one handstone (Figures 18 and 19). The flake tool (5.5.0) is a large (72 g) scraper made from a biface reduction flake and used on one end exhibiting extensive modification through use. No shaping through flaking is evident. One finely worked biface (5.6.0) is made from obsidian, but the rest of the tools are made from basalt. The handstone (5.1.0) is made from vesicular basalt and is 61-x-52-x-30 mm in size. It possesses polish on the grinding surface, and has no striations or pecking. It does not appear to have been shaped. The grinding surface also exhibits a reddish color that may be iron or some remaining pigment. However, it is more likely that the item was used on hide or soft plant materials. Basalt predominates in thedebitage assemblage (Table 9) accounting for 97 percent (n=65) of flakes. Two flakes are made from CCS. One basalt flake possesses cortex.



p:/projects/1010-d24/SouthRouteRp/figure_17.srf

Figure 17. Plan map of site 42TO1867.

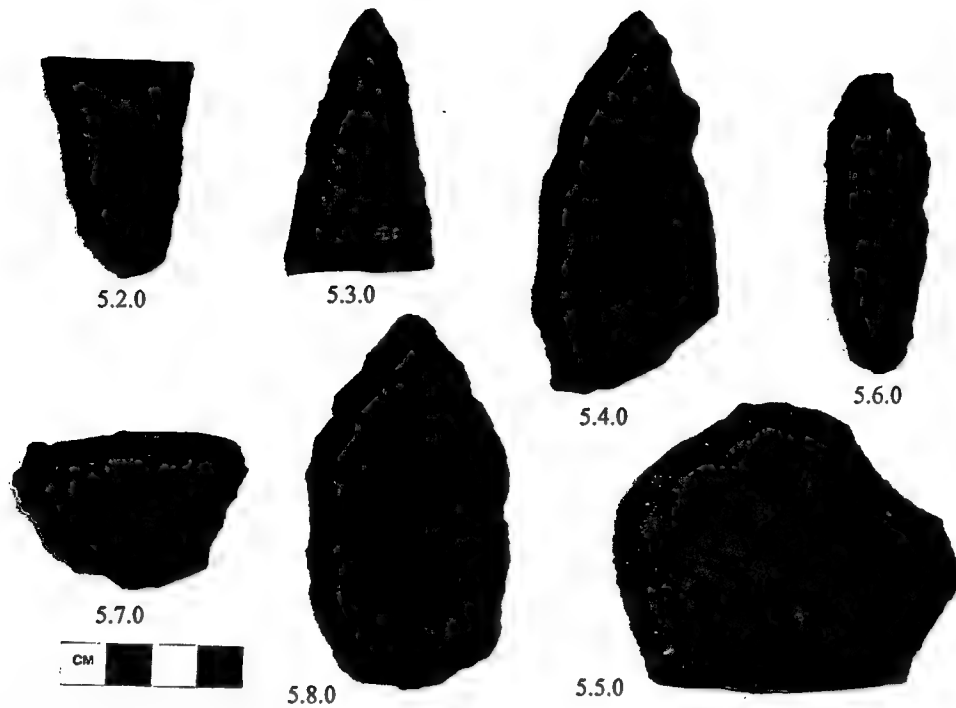


Figure 18. Stone tools from site 42TO1867.



Figure 19. Ground stone from sites 42TO1867 and 42TO1868.

Table 9
Debitage Recorded at Site 42TO1867

	1/8-1/4"	1/4-1/2"	1/2-1"	1-2"	>2"	Totals
Basalt						
Core Reduction			3	2		5
Biface Reduction		7	14	10		31
Indeterminate		8	15	5		28
Shatter			1			1
Totals		15	33	17		65
CCS						
Core Reduction		1	1			2
Totals		1	1			2

Several of the bifaces at site 42TO1868 are larger than those at other sites on the South Route. In contrast to the expended nature of other bifaces, these appear to have broken during manufacture by lateral snap and end shock. Debitage is more concentrated near these bifaces, and large biface reduction flakes indicate that this was a preparatory area rather than a one that was use-oriented. The presence of ground stone and the large size of the site support the possibility that it served a more general purpose than a single task, and could have been a residential base. No potential for intact deposits remains as the artifacts are now situated on a deflated surface.

42TO1868

Site Type: surface lithic scatter

Location: UTM 294528 E 4468700 N

Elevation: 4247 ft

Size: 2,046 m²

Vegetation: pickleweed (*Allenrolfea occidentalis*)

Artifact Numbers: 6.1.0-6.3.0

Site 42TO1868 is very similar to the previously discussed site, 42TO1867. It is a sparse lithic scatter situated on the mudflats 8.4 km southeast of the Wild Isle dune field. A site map is presented in Figure 20. The site sits on the mudflat surface, and is criss-crossed by paleochannels which rise up to 20 cm above the playa surface. Some of these channels are filled with coarse to pea-size gravels which may relate to pre-Gilbert flow of the Old River near its termination. These form a slightly more rugged and higher topographic setting than surrounding mudflats. Gravel channels have not been observed at Wild Isle, less than 10 km to the northwest. Artifacts exhibit less weathering than those at other sites, indicating that they may have been protected by dunes longer than those in other areas.

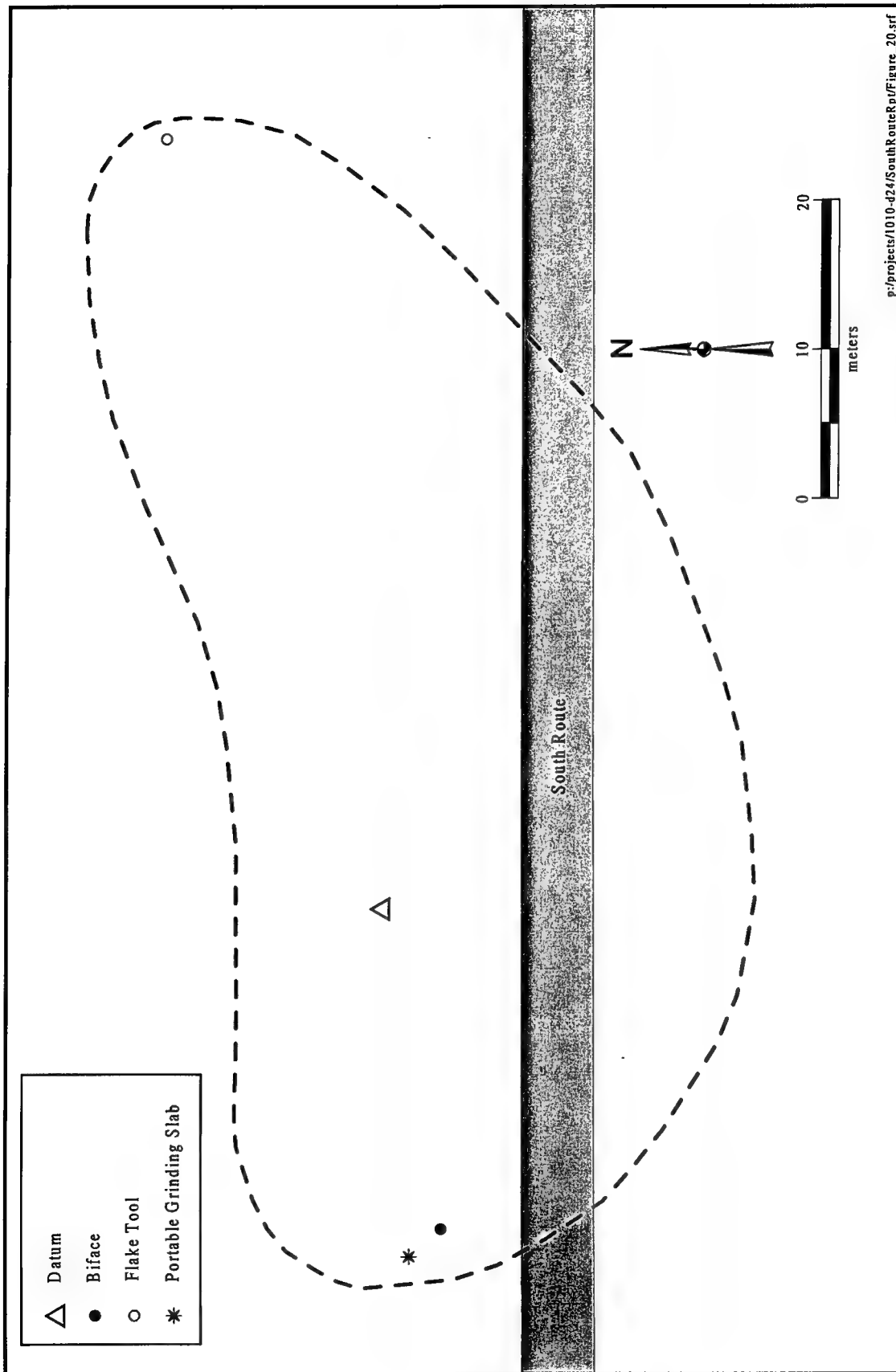


Figure 20. Plan map of site 42TO1868.

Stone tools from the sites consist of one fine percussion biface, one formed flake tool, and one portable grinding slab (Figure 21, see Figure 19). The biface is made from basalt, the flake tool from CCS. The flake tool (6.3.0) is a large (37.5 g) scraper that resembles tool 5.5.0 from site 42TO1867 except that the damaged margin was intentionally shaped. The function for both, however, was probably identical. Four pieces of debitage were recorded (Table 10). These consist of two basalt flakes and two obsidian flakes. One piece of obsidian shatter possesses cortex.

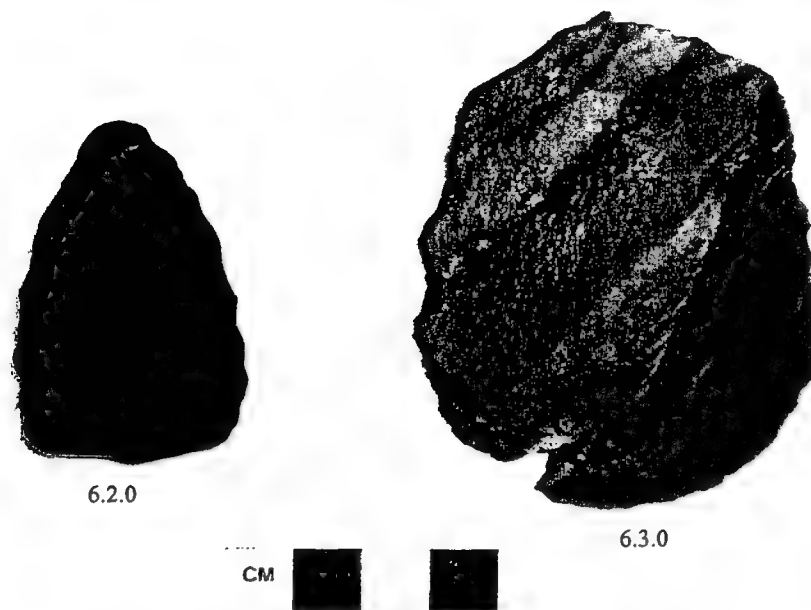


Figure 21. Stone tools from site 42TO1868.

Table 10
Debitage Recorded at Site 42TO1868

	$\frac{1}{8}$ - $\frac{1}{4}$ "	$\frac{1}{4}$ - $\frac{1}{2}$ "	$\frac{1}{2}$ -1"	1-2"	>2"	Totals
Basalt						
Biface Reduction					1	1
Indeterminate		1				1
Totals		1			1	2
Obsidian						
Biface Reduction		1				1
Shatter			1			1
Totals		1	1			2

There are few stone tools present at site 42TO1868, but the site does share a similar context to site 421867. The presence of ground stone also supports the possibility that it served a more general purpose than a single task, and could have been a short-term residential base, although definitive data are not present. No potential for intact deposits remains, as the artifacts are now situated on a deflated surface.

42TO1869

Site Type: surface lithic scatter
Location: UTM 299288 E 4468577 N
Elevation: 4253 ft
Size: 3,773 m²
Vegetation: none
Artifact Numbers: 7.1.0-7.6.0

Site 42TO1869 is a sparse lithic scatter situated on the mudflats 11.6 km southeast of the Wild Isle dune field. There is no vegetation at the site. The appearance of the site setting is a nearly level barren surface that possesses subtle concavity. A site map is presented in Figure 22. Artifacts exhibit extensive weathering.

Six bifaces comprise the stone tool component of the site (Figure 23). Three obsidian bifaces consist of one roughout, one rough percussion, and one rough pressure. Three basalt bifaces consist of one roughout and two rough percussion items. Basalt predominates in the debitage assemblage (Table 11) accounting for 90 percent (n=19) of flakes. Two flakes are made from obsidian. Both obsidian flakes are core reduction flakes, one possessing cortex. These flakes are smaller than those from other sites with the exception of site 42TO1871, with proportionately more flakes from the ¼ to ½-inch size grade than the ½-1-inch grade. There is no potential for intact deposits since the artifacts are situated on a deflated surface.

42TO1870

Site Type: surface lithic scatter
Location: UTM 302393 E 4468351 N
Elevation: 4253 ft
Size: 2,564 m²
Vegetation: none
Artifact Numbers: 8.1.0-8.5.0

Site 42TO1870 is a sparse lithic scatter situated on the mudflats 14.3 km southeast of the Wild Isle dune field. There is no vegetation at the site. The appearance of the site setting is a nearly level barren surface that possesses slight concavity. A site map is presented in Figure 24. Artifacts exhibit extensive weathering.

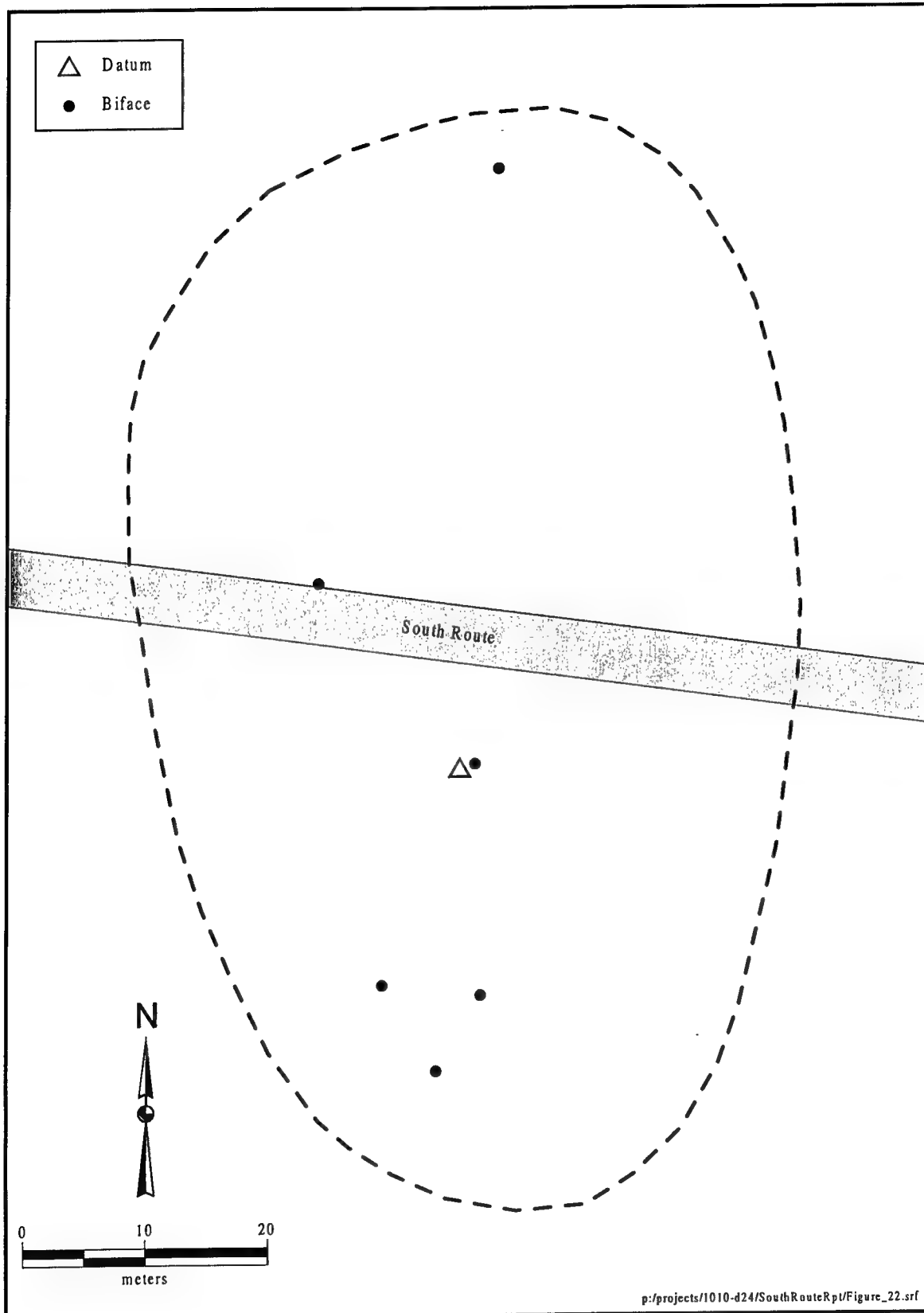


Figure 22. Plan map of site 42TO1869.

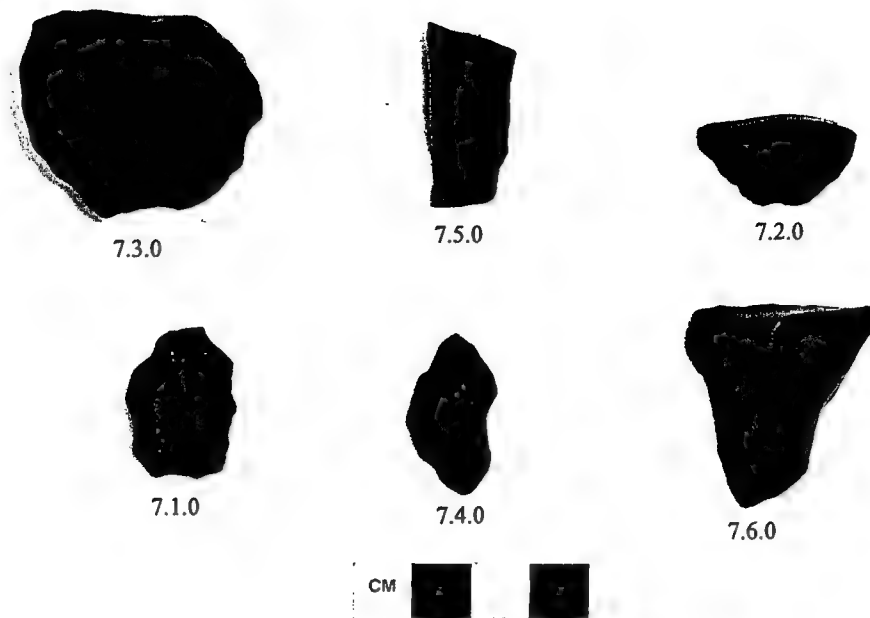


Figure 23. Stone tools from site 42TO1869.

Table 11
Debitage Recorded at Site 42TO1869

	$\frac{1}{8}$ - $\frac{1}{4}$ "	$\frac{1}{4}$ - $\frac{1}{2}$ "	$\frac{1}{2}$ -1"	1-2"	>2"	Totals
Basalt						
Core Reduction		2	2	1		5
Biface Reduction		4				4
Indeterminate		5	2	1		8
Shatter		2				2
Totals		13	4	2		19
Obsidian						
Core Reduction		1	1			2
Totals		1	1			2

The tool assemblage consists of four basalt bifaces and one obsidian Western Stemmed point (Figure 25, also see Figure 6). The bifaces are all rough percussion. Basalt predominates in thedebitage assemblage (Table 12) accounting for 86 percent (n=12) of flakes. Two flakes are made from obsidian. One indeterminate basalt flake possesses cortex. There is no potential for intact deposits since the artifacts are situated on a deflated surface.

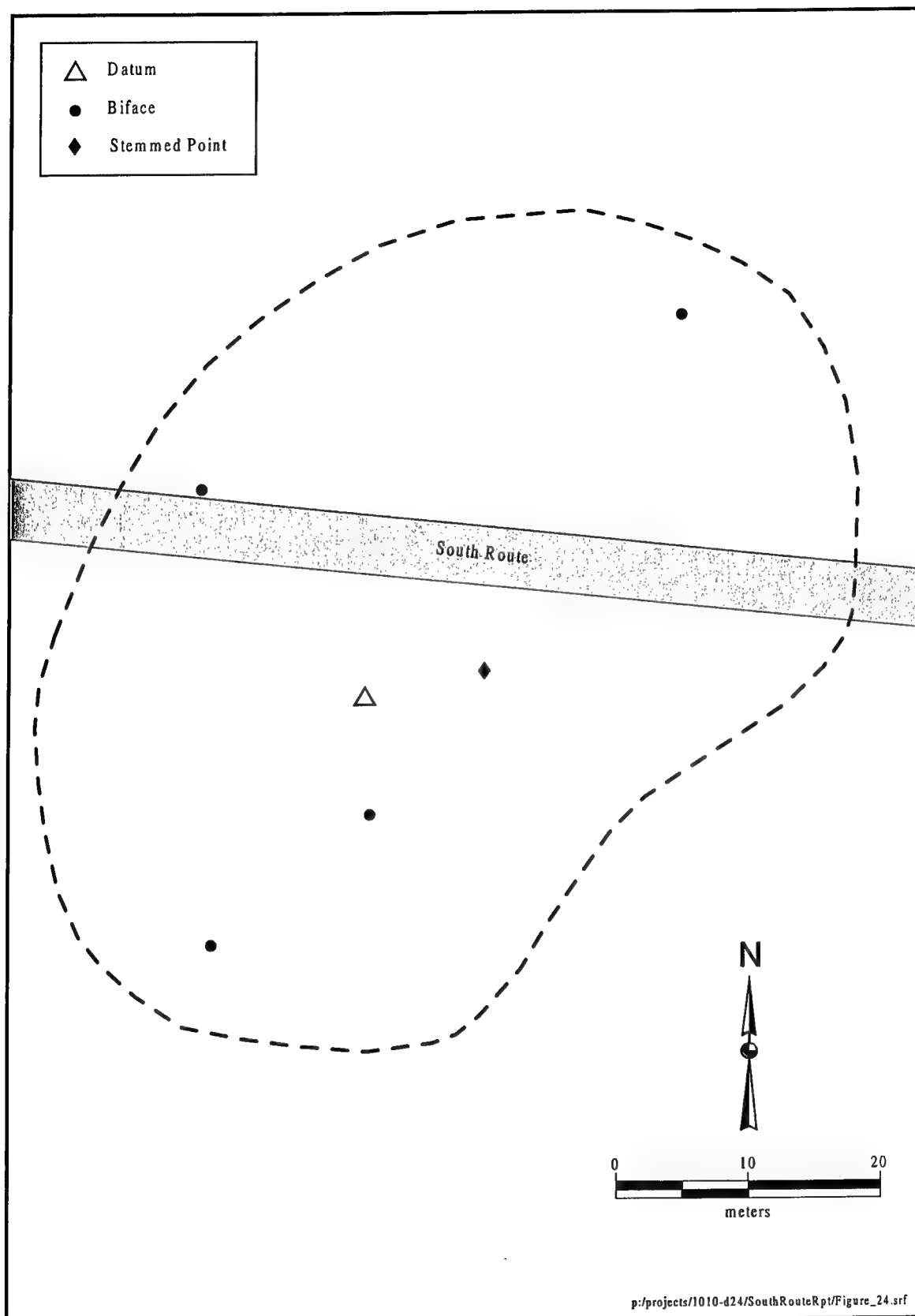


Figure 24. Plan map of site 42TO1870.

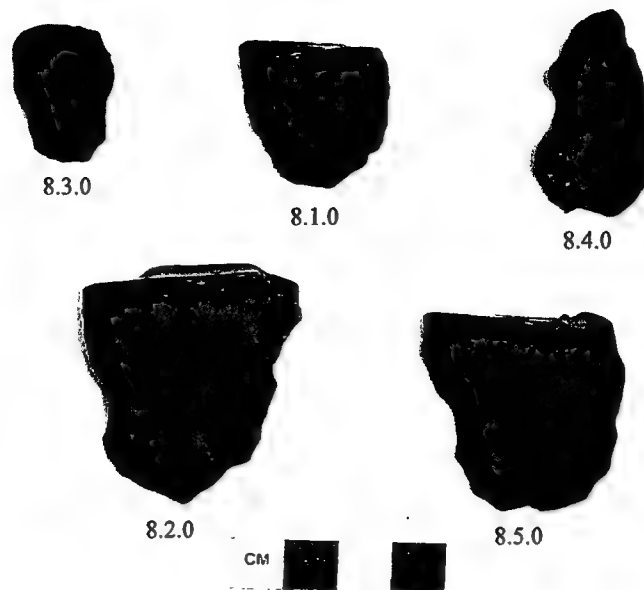


Figure 25. Stone tools from site 42TO1870.

Table 12
Debitage Recorded at Site 42TO1870

	$\frac{1}{8}$ - $\frac{1}{4}$ "	$\frac{1}{4}$ - $\frac{1}{2}$ "	$\frac{1}{2}$ -1"	1-2"	>2"	Totals
Basalt						
Core Reduction			2			2
Indeterminate		2	5	3		10
Totals		2	7	3		12
Obsidian						
Indeterminate			2			2
Totals			2			2

42TO1871

Site Type: surface lithic scatter
Location: UTM 303355 E 4468266 N
Elevation: 4254 ft
Size: 769 m²
Vegetation: none
Artifact Numbers: 9.1.0-9.2.0

Site 42TO1871 is a sparse lithic scatter situated on the mudflats 14.7 km southeast of the Wild Isle dune field. There is no vegetation at the site. The appearance of the site setting is a nearly level barren surface that possesses subtle concavity. A site map is presented in Figure 26. Artifacts exhibit extensive weathering.

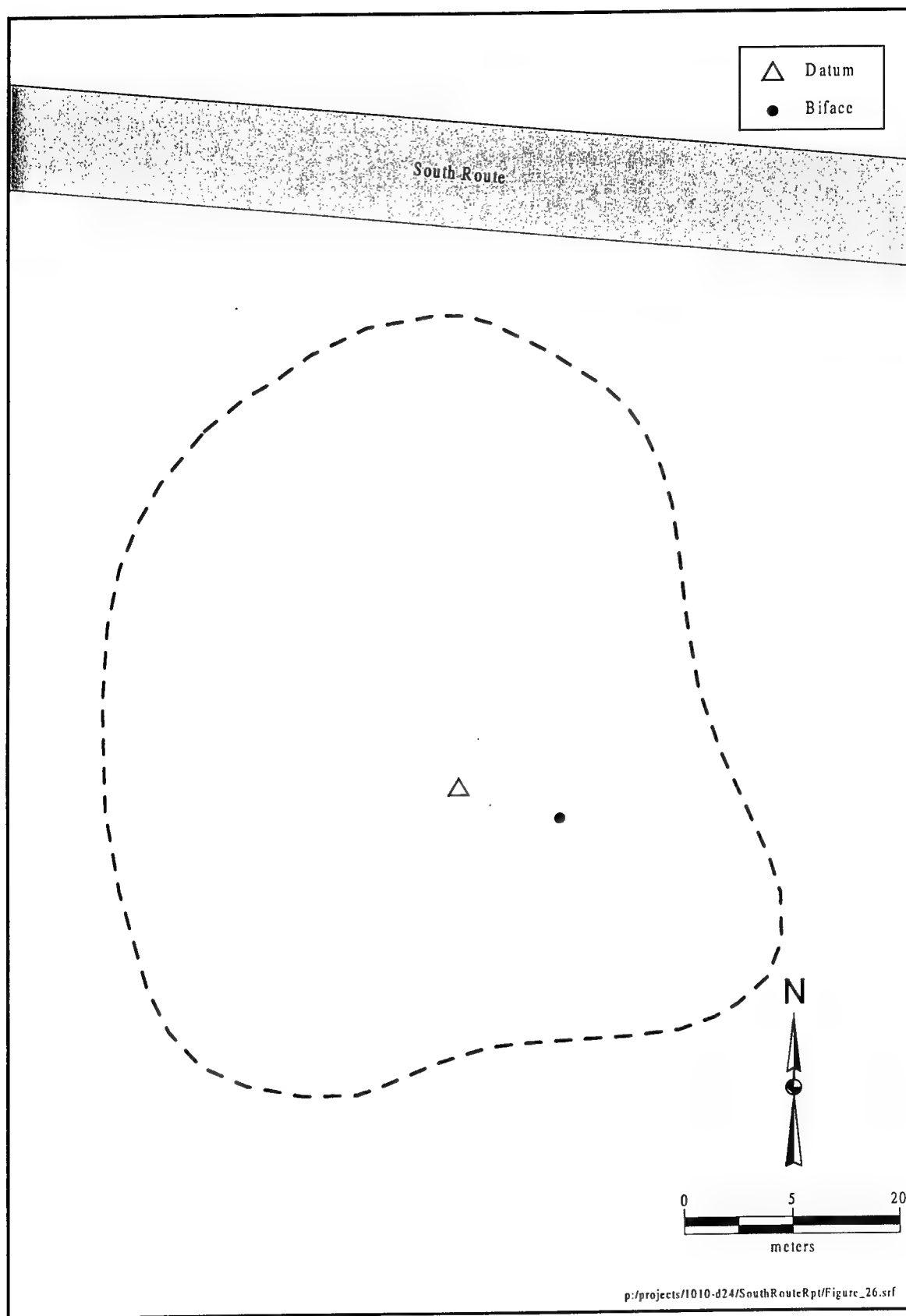


Figure 26. Plan map of site 42TO1871.

One obsidian rough pressure biface constitutes the tool assemblage (Figure 27). Basalt predominates in the debitage assemblage (Table 13) accounting for 92 percent (n=11) of flakes. One flake is made from obsidian. No artifacts possess cortex. These flakes are smaller than those from other sites with the exception of 42TO1869, with proportionately more flakes from the 1/4 to 1/2-inch size grade than the 1/2-1-inch grade. There is no potential for intact deposits since the artifacts are situated on a deflated surface.

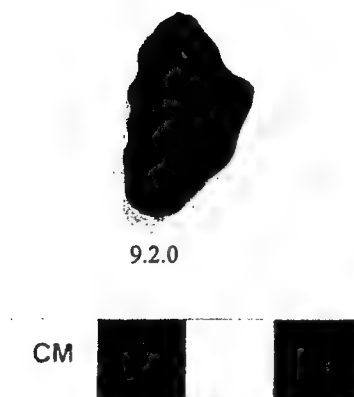


Figure 9. Stone tool from site 42TO1871.

Table 13
Debitage Recorded at Site 42TO1871

	1/8-1/4"	1/4-1/2"	1/2-1"	1-2"	>2"	Totals
Basalt						
Core Reduction		2	1			3
Biface Reduction				2		2
Indeterminate		3	2			5
Shatter		1				1
<i>Totals</i>		6	3	2		11
Obsidian						
Indeterminate			1			1
<i>Totals</i>			1			1

SUMMARY

The South Route sites and artifacts are all sparse lithic scatters comprised of basalt and obsidian artifacts. While projectile points of the Western Stemmed Series were only found at some of the sites, no other point styles were observed; however, the weathering, mudflat context, similarity to numerous sites at Wild Isle, and overall nature of the lithic technology suggest that all of the sites represent Paleoarchaic activities. The sites are also associated with ancient Old River system stream channels, which dried up over 9,000 years ago.

While similar in character, there are subtle differences among some of the sites. Sites 42TO1867 and 42TO1868 are associated with distinctive Old River gravel channels, as opposed to the large network of criss-crossing sand channels that extends to Wild Isle and east, and may reflect more intensive activities. Ground stone is present at these sites, as well as biface manufacture. Other sites do not contain this artifact diversity and tools appear to be expended. This suggests task-specific activities at these sites. Sites 42TO1869 and 42TO1871 contain smaller artifacts in depressed mudflat areas. It is possible that some of these artifacts moved here through natural processes. These possibilities are addressed along with research questions in the next chapter.

CHAPTER 7

CONCLUSIONS

The sites recorded on the South Route are sparse, surface lithic scatters, but their unique setting and temporally discrete nature provide them some interpretive potential when combined. Early lifeways in the Great Basin are not well understood, so the archaeological sites of the greater Wild Isle area are valuable resources. This chapter addresses the research questions proposed for the South Route.

RESEARCH QUESTIONS

1) Can residential sites be distinguished from task-oriented sites?

It was predicted that both task-specific and residential sites should be present along the South Route since it is removed from any otherwise suitable areas. Some data were observed that are consistent with the predicted patterns for different site types, but they are not conclusive. A third site type resulting from artifact redeposition through natural processes is also present.

South Route sites possess two types of data that pertain to the question of distinguishing task-specific from residential sites: natural setting and artifact diversity. Two sites are located on or adjacent to gravel channels of the Old River drainage system (Figure 28). These inverted channels and levee systems are more topographically distinctive than the braided sand channel system that extends northwest into Wild Isle. The levee systems could have provided favorable living surfaces (Carter and Hirschi 2002). People would have used levee areas throughout the marshland to conduct activities, and those associated with the Old River were probably more developed (extending back to pre-Gilbert times) than those of the meandering, low-energy streams that likely drained the area during occupation.

Artifact function and type are more diverse on the gravel channels than in other sites. Gravel channel sites are represented by sites 42TO1867 and 42TO1868. The remaining non-gravel channel sites contain stemmed points, bifaces, flake tools, and debitage, but these all represent use-related activities. Tools possess diminutive sizes, averaging 10.2 g per item, compared to those from gravel channel sites, which are substantially larger at 30.7 g per artifact. It was predicted that the manufacture of stone tools should take place at residential bases. Site 42TO1867 contains this evidence. In addition to the expended tools typical of South Route sites,

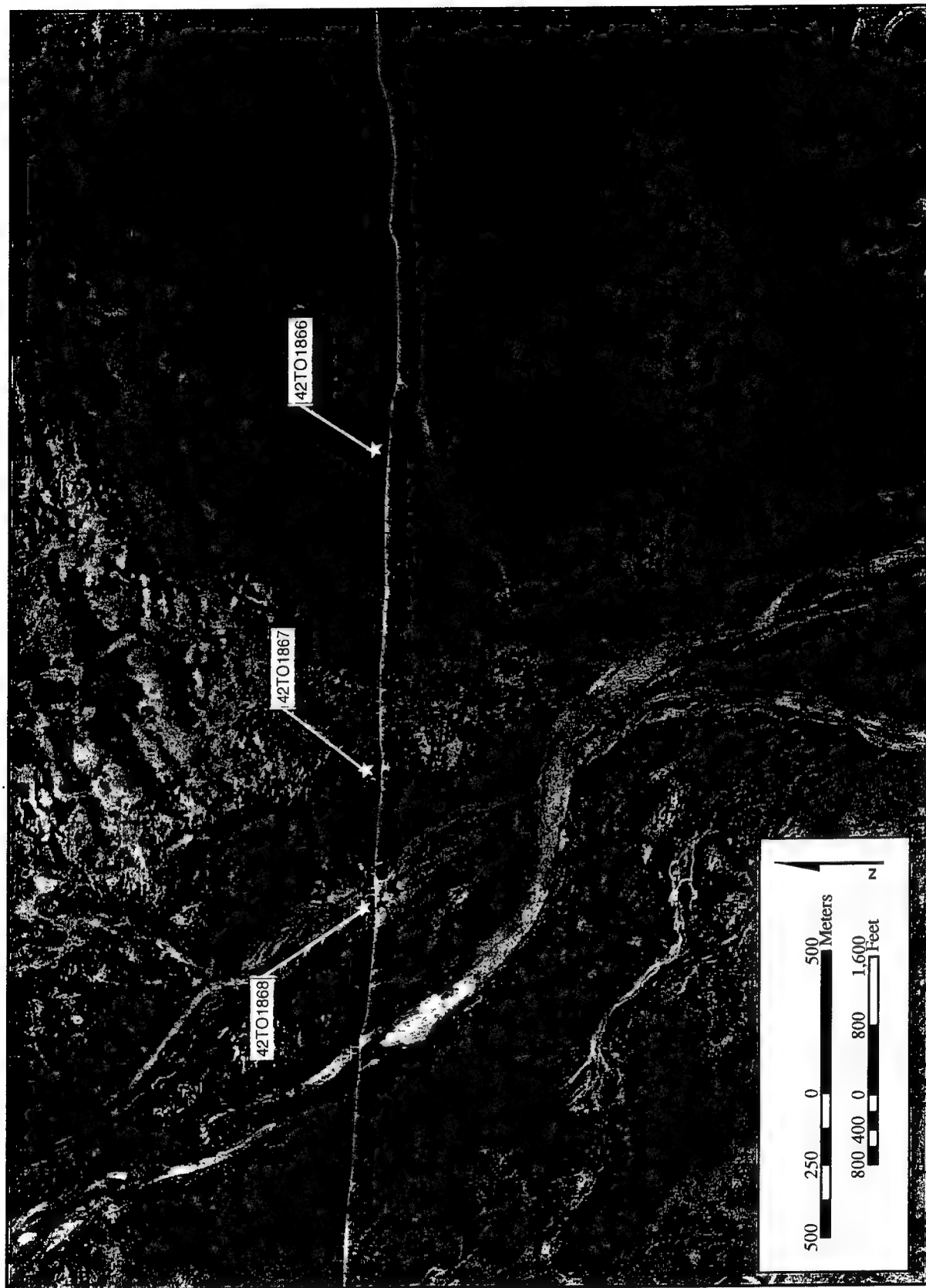


Figure 28. South Route archaeological sites adjacent to Old River gravel channels.

large basalt bifaces broken during the shaping process were present, as well as one stemmed point that was discarded upon failure to provide a proper blade form. Debitage of appropriate size and type (i.e., biface reduction) associated with these items also supports this interpretation. It should be noted, however, that resharpening debitage as a whole was not observed at any site, and assuming these flakes were present, it is likely that at less than 1/4-in they have blown away across the playa. Ground stone is present at sites 42TO1867 and 42TO1868, indicating a greater diversity of activities. The South Route data are too scant to demonstrate residence, but they are consistent with the predictions in a relative sense to other sites and warrant consideration as basic models in future investigations.

It was thought that site size might be an indicator of function (e.g., larger sites equal residential sites), but this is not apparent. Those sites speculated as possible residences (42TO1867, 42TO1868) are larger than most South Route sites, but site 42TO1864, for example, is also relatively large without possessing comparable artifact diversity. Similar sites are reported at Wild Isle (Carter 1999; Carter and Young 2002). It is possible that high mobility would result in residential sites no larger than those task-specific sites conducive to revisits for fixed resources. Nevertheless, the predicted pattern did not hold and complicating factors, such as site revisiting and frequency of residential movement, should be more carefully considered.

Sites to the east of the gravel channels may be more influenced by natural processes than human activities. Sites 42TO1869, 42TO1870, and 42TO1871 are situated in vast slightly-depressed areas of the mudflats that are conducive to ponding with greater seasonal moisture. UTTR range personnel state that these conditions have occurred several times in recent decades. These areas may serve as collection basins for small artifacts winnowed out of other sites by aeolian forces. Over the course of thousands of years, wind combined with water, ice, and the level terrain, can move artifacts across the playa, especially smaller items (Carter and Hirschi 2002).

If a site were produced by these processes, artifacts should be smaller on average than those from true sites. Artifact counts are low, but this appears to be the case at sites 42TO1869 and 42TO1871. Small "odds and ends" occur, such as bifacial fragments that appear to be pieces of stemmed points but are too fragmented and weathered to be positively identified. Together tools from these sites weigh an average of 1.4 g per item, substantially smaller than at other sites. This is not, however, the case at site 42TO1870 (10.1 g/tool) even though it is situated in the same topographically depressed context. It is not intended here to interpret sites separately as human-generated or naturally-produced, although this may be the case at times, but rather to suggest the primary processes affecting 8,500-year-plus site formation on this open playa. The sites on the eastern portion of the South Route are all downwind from the prevailing winds. It is likely that the influence of human activities versus the small artifact transport and redeposition becomes more complicated moving eastward. Sites generated on the western margins of the wetlands should be more representative of human activities only, characterized by lag deposits of larger artifacts.

2) *Did people intend to use the area for short or long durations?*

Paleoarchaic technology on the South Route, and by extension the greater Wild Isle area, seems at once to indicate both high and low mobility. Basalt dominates as a raw material and reduction strategies indicate long-term stays relative to other areas of the eastern Great Basin. Basalt was used in a planned expedient (i.e., crude) manner. Fifty-three percent (n=26 of 49) of all bifaces

and stemmed points possess remnant blank evidence of some kind. Biface counts are too low to track the occurrence rates of these attributes through the entire size range. Systematic biface thinning is apparent on only a few basalt bifaces. The lack of emphasis on thinning appears to be a requirement for cost-effective use of basalt, as discussed in the research design. Research on Martis basalt use in the Sierra Nevada revealed an almost identical reduction approach, but this could not be separated from the positive effects of toolstone abundance (Duke 1998). Toolstone is not abundant near the South Route, however, and while the source is not known, it appears to be at least 30 km away. This would be a considerable distance if toolstone supplies needed frequent replenishment.

Paleoarchaic toolmakers appear to have offset the failure risks of using basalt by opting for an alternative biface reduction strategy. Rather than thin bifaces into a useable form, people roughed out thin flake blanks of different sizes for use and then resharpened them to expenditure. Separate trajectories could have fulfilled the necessary tool size requirements. The desired range of edge angles would be maintained by blank thinness staggered through this size range. It is not that thinning was never applied, but only to an acceptable (i.e., low-risk) degree; it is not the priority that best typifies biface reduction in the Wild Isle area.

This reduction approach comes with additional restrictions. The most obvious is the need for frequent access to sources. In the research design, a distinction was made between the *provisioning of individuals* and the *provisioning of place*. Basalt reduction in the South Route project area indicates the provisioning of a place (i.e., stockpiling). It is known that the area was biotically productive, and the manufacture of basalt bifaces did take place here. Stone probably entered sites in the form of various sizes of blanks. Block cores and large core reduction flakes were not observed. There was insufficient evidence to determine if basalt bifaces were also used as cores, but flake tools seemingly too large to have come from bifaces were a component of the assemblages. Groups using this portion of the Bonneville Basin apparently planned to stay long enough to make the extended logistics of basalt procurement worthwhile. The alternative possibility that the Wild Isle area was a waypoint along a long-distance mobile round is less likely. In this scenario, expedient basalt use would have to be explained by such rapid movement and widespread geologic sources that there would be little need for highly transportable tools. Basalt does appear to be well-distributed across the Great Basin, but not to the extreme extent required for this hypothesis to be viable.

Further support for relatively long stays in the greater Wild Isle area come from toolstone selection. It was expected that the longer people stayed in the area, the more reliant they should have become on basalt. This is the case, with basalt predominating in the assemblages at 70 percent (n=48 of 69). Moreover, artifact types such as small flake tools and projectile points which are frequently made from CCS and obsidian in neighboring areas (see Beck and Jones 1990) are often made from basalt on the South Route and at Wild Isle (Carter 1999; Carter and Young 2002). No definitive statement can be made about how long "long duration" is, although it is probably a full season at most, but it appears to be a greater period of time than in other eastern Great Basin locations.

3) *Is lithic technology designed more toward plants and small game or large migratory animals?*

While most North American Paleoindians relied heavily on large migratory game, early Great Basin peoples are thought to have focused on lake margin marsh resources. The people using the South Route and Wild Isle areas were undoubtedly there to exploit marsh resources, but does

their lithic technology indicate this as an overall organizational priority? Expedient reduction methods, a preference for basalt toolstone, and the similarity of these attributes to other parts of the Great Basin suggest that this is the case.

Much of how South Route technology relates to this question is discussed in the previous question. A focus on large migratory game should manifest itself in a highly curated, transportable toolkit, but basalt use indicates stays of relatively long duration. Emphasis on marsh resources (i.e., plants and small animals) is the explanation most consistent with these findings. Antelope, mule deer, and bison were surely taken as well, but these were not followed across the landscape residually. Of notable importance is the issue of sharpness, for which basalt is exceedingly deficient.

For butchering purposes basalt tools are only suitable, but for plant procurement activities such as the mass collection and processing of reedy marsh plants, they may be efficient and durable tools. Obsidian could have provided additional sharp edges as necessary for other marsh resources (e.g., small game) or economic tasks. Even stemmed points, which are so abundant in the area, are probably best considered as multi-purpose hafted knives rather than strictly as projectile points. Beyond the intuitive suggestion that there are too many stemmed points to be intended solely for hunting large animals, however, there is no definitive evidence for this interpretation. Since South Route stone tools compare well with those in other parts of the Great Basin, this likely reflects a technological approach that applies beyond the unique marsh setting of the Wild Isle area. Unfortunately, the presence or absence of edge damage could not be used as clear evidence either way due to artifact weathering.

4) Could lithic materials have been traded into the project area?

No obsidian from closer than 80 km away at Topaz Mountain has been sourced in the greater Wild Isle area (Arkush and Pitblado 2000:22-24). Three scenarios are possible: (1) trade, (2) direct procurement from the source, and (3) procurement from caches. Trade among Paleoarchaic peoples is not considered likely by most Great Basin archaeologists (see Beck and Jones 1997), but it is possible in the Wild Isle area. Basalt technology suggests that logistical trips of minimally 30 km were undertaken. Trips of 80 km or greater is difficult to conceive, but possible. However, the possibility that people met with others to exchange for obsidian is no less viable. The possibility that caches were set up in such an important area is also viable, whether material was acquired through trade or direct procurement.

5) When did activities take place?

No organic data, such as charcoal, faunal remains, or macrobotanical remains were found on the South Route survey to provide accurate dating of activities. However, only WST projectile points were recovered, indicating that humans have not used the playa surface since early occupation of the extensive wetland area over 8,500 years ago.

CHAPTER 8

SUMMARY AND RECOMMENDATIONS

The South Route inventory yielded nine archaeological sites and 43 isolated artifacts. These cultural resources represent the activities of some of the earliest peoples of the Great Basin. Research questions were asked of these data to assess their value to the regional archaeological problems, and finally, their eligibility for inclusion on the NRHP.

RESEARCH VALUES AND RECOMMENDATIONS FOR FUTURE WORK

The South Route sites are typical of other sites in the greater Wild Isle area. They are sparse lithic scatters of basalt and obsidian flaked stone tools and debitage situated on deflated surfaces. An association with the remnant sand and gravel channels of the Old River drainage system is the last vestige of a reason for their occurrence. It was not possible to assess the specific timing of these occupations because intact deposits have long-since eroded away. Nevertheless, the abundance of discrete Paleoarchaic material has provided several insights.

It appears that the groups using lake-margin wetlands following the Gilbert regression about 10,300 years ago resided here for some duration, although they may have moved within the area frequently. Evidence for home bases was not conclusive, but what was observed suggests short-term residency. Plants and small animals appear to have been the dietary focus rather than large game animals. These characteristics can be considered a combination of both Paleoindian and Archaic hallmarks.

Evidence for these patterns comes from lithic technology. Reliance on basalt indicates that people had to procure stone on logistical trips rather than move the entire group near the material. This would only be cost-effective if lengthy stays were planned. As discussed in the research design, several regional researchers (e.g., Elston 1994; Jones and Beck 1999) have speculated on the seemingly odd reliance on basalt by mobile Paleoarchaic peoples. The Wild Isle-South Route case indicates that the answer may lie in recognizing relationships between mobility and residency that are unique to the patchy nature of Great Basin resources. Basalt may be the most evenly distributed and abundant toolstone in the region, and its selection over superior, more localized materials suggests an organizational perspective of broad areal range, functional requirements notwithstanding. However, the manner in which basalt was used suggests that

when people were in place, they intended to exploit these basins intensively. It is possible that Paleoarchaic peoples did not possess highly transportable technologies simply because their destinations were so predictable. Much like later peoples, Paleoarchaic groups probably had flexible land use systems and chose different basins annually depending on productivity. Unlike later Great Basin hunter-gatherers, however, they had more valley settings to choose from and less population density to confine them.

Future research should consider two primary issues related to lithic technology. The first is approximating the use life of a basalt tool. This is important for understanding the limiting factors of basalt resource use on tool function and mobility. This would be difficult since there is a lack of ethnographic examples for exactly how stone tools were used, but experimental studies can be used to model the possibilities. Even more problematic is determining the kinds of tasks performed with stone tools as a prerequisite to any examination of use life. Use wear evidence is not likely to be available, but integration of experimental studies and toolstone selection models with subsistence models in optimal foraging theory is one understudied area of potential.

The second technological issue is more readily addressed. Basalt X-ray fluorescence (XRF) sourcing is now available and should be conducted on basalt artifacts. Major basalt sources must be identified. Basalt sourcing could be particularly informative for observing basin-to-basin movements since basalt tools are expected to drop in and out of toolkits more quickly than those made from obsidian. Obsidian is often the focus of sourcing studies because it reflects the maximum distance people either traveled or interacted. This information would be complemented by the finer-scale spatial data generated in basalt sourcing studies. These data have the potential to clarify the short-range movements that account for annual mobile rounds. It is also possible that the association of these land use patterns with assemblage variability (e.g., stemmed point types, toolstone choices, toolkit components) can be used to ferret out chronological patterning within the Paleoarchaic.

RECOMMENDATIONS FOR NRHP ELIGIBILITY

Nine sites were recorded and examined for eligibility under 36 CFR 60.4 (Table 14). Taken together, the South Route sites are capable of adding to an understanding of regional prehistory, but individually, none possesses the integrity or data quality to answer questions important to prehistory (i.e., Criterion D). Vertical integrity is destroyed on the mudflats by substantial deflation, and horizontal integrity is minimal since many artifacts, especially the smaller ones, have been blown around and redeposited in other areas and sites. Radiocarbon dating at these sites is impossible. All nine sites are considered ineligible for inclusion on the NRHP.

Table 14
National Register of Historic Places Eligibility for South Route Sites

Site	Type	NRHP Eligibility
42TO1863	Lithic scatter	Ineligible
42TO1864	Lithic scatter	Ineligible
42TO1865	Lithic scatter	Ineligible
42TO1866	Lithic scatter	Ineligible
42TO1867	Lithic scatter	Ineligible
42TO1868	Lithic scatter	Ineligible
42TO1869	Lithic scatter	Ineligible
42TO1870	Lithic scatter	Ineligible
42TO1871	Lithic scatter	Ineligible

REFERENCES CITED

Aikens, C. M.

1966 Frémont-Promontory-Plains Relationships, Including a Report of Excavations at the Injun Creek and Bear River Number 1 Sites, Northern Utah. *University of Utah Anthropological Papers* 82, Salt Lake City.

1970 *Hogup Cave*. University of Utah Anthropological Papers No. 93. University of Utah Press, Salt Lake City.

Aikens, C. M., and D. B. Madsen

1986 Prehistory of the Eastern Area. In *Great Basin*, edited by W. L. d'Azevedo, pp. 149-160. Handbook of North American Indians, Vol. 11, W. C. Sturtevant, general editor. Smithsonian Institution, Washington, D.C.

Amick, D. S.

1995 Raw Material Selection Patterns among Paleoindian Tools from the Black Rock Desert, Nevada. *Current Research in the Pleistocene* 12:55-57.

1996 *Folsom Diet Breadth and Land Use in the American Southwest*. Ph.D. dissertation, Department of Anthropology, University of New Mexico, Albuquerque.

Antevs, E.

1948 Climatic Changes and the Pre-White Man. In *The Great Basin with Emphasis on Glacial and Post-Glacial Times*, pp. 168-191. University of Utah Biological Series Bulletin, Volume 38, No. 20.

Arkush, B.

1993 *An Archaeological Assessment of U.S. Air Force Utah Test and Training Range: The 1993 Field Season*. Submitted to Directorate of Environmental Management, Ogden Air Logistics Center, Hill Air Force Base, Contract No. F42650-93-D-0053-5004. Copies available from Hill Air Force Base, Ogden, Utah.

- 1994 *An Archaeological Assessment of U.S. Air Force Utah Test and Training Range: The 1994 Field Season.* Submitted to Directorate of Environmental Management, Ogden Air Logistics Center, Hill Air Force Base, Contract No. F42650-93-D-0053-5004. Copies available from Hill Air Force Base, Ogden, Utah.
- 1995 *An Archaeological Assessment of U.S. Air Force Utah Test and Training Range: The 1995 Field Season.* Submitted to Directorate of Environmental Management, Ogden Air Logistics Center, Hill Air Force Base, Contract No. F42650-93-D-0053-5004. Copies available from Hill Air Force Base, Ogden, Utah.
- 1997 *An Archaeological Assessment of U.S. Air Force Utah Test and Training Range: The 1996 Field Season.* Submitted to Directorate of Environmental Management, Ogden Air Logistics Center, Hill Air Force Base, Contract No. F42650-93-D-0053-5004. Copies available from Hill Air Force Base, Ogden, Utah.
- Arkush, B., and B. L. Pitblado
2000 Paleoarchaic Surface Assemblages in the Great Salt Lake Desert, Northwestern Utah. *Journal of California and Great Basin Anthropology* 22(1):12-42.
- Arkush, B., and G. W. Workman
1993a *An Archaeological Assessment of the U.S. Air Force Utah Test and Training Range: The 1992 Field Season.* Report prepared for the U.S. Department of Defense, Hill Air Force Base, Ogden, Utah.
- 1993b *An Archaeological Assessment of the U.S. Air Force Utah Test and Training Range: The 1993 Field Season.* Report prepared for the U.S. Department of Defense, Hill Air Force Base, Ogden, Utah.
- Arkush, B., G. W. Workman, and W. B. Fawcett
1992 *A 1991 Archaeological Assessment of the U.S. Air Force Designated Lands.* Report prepared for the U.S. Department of Defense, Hill Air Force Base, Ogden, Utah.
- Bamforth, D. B.
1986 Technological Efficiency and Tool Curation. *American Antiquity* 51(1):38-50.
- Bamforth, D. B., and P. Bleed
1997 Technology, Flaked Stone Technology, and Risk. In *Rediscovering Darwin: Evolutionary Theory in Archaeological Explanation*, edited by C. M. Barton and G. A. Clark, pp. 109-140. Archaeological Papers of the American Anthropological Association No. 7, Arlington.
- Beck, C., and G. T. Jones
1990 Toolstone Selection and Lithic Technology in Early Great Basin Prehistory. *Journal of Field Archaeology* 17:283-299.
- 1997 The Terminal Pleistocene/Early Holocene Archaeology of the Great Basin. *Journal of World Prehistory* 11(2):161-236.

- Bedwell, S. F.
1973 *Fort Rock Basin Prehistory and Environment*. University of Oregon Books, Eugene.
- Bettinger, R. L.
1991 *Hunter-Gatherers: Archaeological and Evolutionary Theory*. Plenum Press, New York.
- Bettinger, R. L., and M. A. Baumhoff
1982 The Numic Spread: Great Basin Cultures in Competition. *American Antiquity* 47(3):485-503.
- Binford, L. R.
1973 Interassemblage Variability: The Mousterian and the Functional Argument. In *The Explanation of Culture Change: Models in Economic Prehistory*, edited by C. Refrew, pp. 227-254. Duckworth, London.
1977 Forty-Seven Trips: A Case Study in the Character of Archaeological Formation Processes. In *Stone Tools as Cultural Markers: Change, Evolution, and Complexity*, edited by R. V. S. Wright, pp. 178-188. Australian Institute of Aboriginal Studies, Canberra.
1979 Organization and Formation Processes: Looking at Curated Technologies. *Journal of Anthropological Research* 35(3):255-272.
- Bleed, P.
1986 The Optimal Design of Hunting Weapons: Maintainability or Reliability. *American Antiquity* 51(4) 737-747.
- Bryan, A. L.
1965 Paleo-American Prehistory. *Occasional Papers of the Idaho State University Museum*, No. 16, Pocatello.
1979 Smith Creek Cave. In *The Archaeology of Smith Creek Canyon, Eastern Nevada*, edited by D. R. Tuohy and D. L. Randall, pp. 162-253. Nevada State Museum Anthropological Papers 17, Carson City.
- Butler, R. B.
1961 The Old Cordilleran Culture in the Pacific Northwest. *Occasional Papers of the Idaho State University Museum*, No. 5, Pocatello.
- Carter, J.
1999 *TS-5 Target Complex Cultural Resource Inventory, Wendover Air Force Range, Tooele County, Utah*. Historical Research Associates, Inc. Submitted to Hill Air Force Base and National Park Service, Contract No. 1443-CX-1200-94-024. Copies available from Hill Air Force Base, Ogden.

Carter, J., and J. Hirschi

- 2002 *Leaving the Levees: Spatial Distribution Patterns and Problems at Southern Great Salt Lake Desert Open-Air Sites*. Paper presented at the 28th Great Basin Anthropological Conference, Elko.

Carter, J., and D. C. Young

- 2002 *TS-5 Central Area and Craners Cultural Resources Inventory, Utah Test and Training Range, Tooele and Box Elder Counties, Utah*. Historical Research Associates, Inc. Submitted to Hill Air Force Base and National Park Service, Contract No. 1443-CX-2000-99-003. Copies available from Hill Air Force Base, Ogden.

Currey, D. R.

- 1980 Coastal Geomorphology of Great Salt lake and Vicinity. In *Great Salt Lake: A Scientific, Historical, and Economic Overview*, edited by J. W. Gwynn, pp. 69-82. Utah Geological and Mineral Survey Bulletin 116, Salt Lake City.
- 1982 *Lake Bonneville: Selected Features of Relevance to Neotectonic Analysis*. U.S. Geological Survey Open-File Report 82-1070, Denver.
- 1990 Quaternary Paleolakes in the Evolution of Semidesert Basins, with Special Emphasis on Lake Bonneville and the Great Basin, U.S.A. *Palaeogeography, Palaeoclimatology, Palaeoecology* 76:189-214.

Currey, D. R., and S. R. James

- 1982 Paleoenvironments of the Northeastern Great Basin and Northeastern Basin Rim Region: A Review of Geological and Biological Evidence. In *Man and Environment in the Great Basin*, edited by D. B. Madsen and J. F. O'Connell, pp.27-52. Society for American Archaeology Papers 2, Washington D.C.

Currey, D. R., and C. G. Oviatt

- 1985 Durations, Average Rates, and Probably Causes of Lake Bonneville Expansions, Stillstands, and Contractions during the Last Deep-Lake Cycle, 32,000 to 10,000 Years Ago. In *Problems of and Prospects for Predicting Great Salt Lake Levels: Papers from a Conference held in Salt Lake City, March 26-28, 1985*, edited by P. A. Kay and H. F. Diaz, pp. 9-24. Center for Public Affairs and Administration, University of Utah, Salt Lake City.

Davis, E. L.

- 1967 Man and Water at Pleistocene Lake Mohave. *American Antiquity* 32(3):345-353.
- 1968 Early Man in the Mojave Desert. In *Early Man in Western North America: Symposium of the Southwest Anthropological Association, 1968*, edited by C. Irwin-Williams, pp.42-47. *Eastern New Mexico University Contributions in Anthropology* 1(4).

Davis, E. L., C. W. Brott, and R. Shutler, Jr.

- 1969 The Western Lithic Co-Tradition. *San Diego Museum Papers*, No. 6, San Diego.

- Deunert, B.
1995 *A Fundamental Basalt Flake Analysis*. BAR International Series 614, Oxford.
- Drews, M. P.
1990 The Dietary Role of Freshwater Shellfish from Stillwater Marsh. In *Wetland Adaptations in the Great Basin*, edited by J. C. Janetski and David B. Madsen, pp. 63-74. Brigham Young University Museum of Peoples and Cultures No. 1, Provo.
- Duke, D.
1998 *Basalt Resource Use and Technological Organization in the North-Central Sierra Nevada*. Master's thesis, University of Nevada, Reno. University Microfilms, Ann Arbor.

2002 *Archaeological Monitoring of Target and Access Road Development for the TS-5-2 Target Area, Utah Test and Training Range, Tooele County, Utah*. U.S. Air Force Air Combat Command Series, Reports of Investigations Number 12. Geo-Marine, Inc., Las Vegas. Submitted to U.S. Army Corps of Engineers, Fort Worth District, and Hill Air Force Base, Utah.
- Duke, D., M. C. Slaughter, C. Lowry, M. Goetz, and B. Knight
2001 *A Field Test of the Traveler-Processor Model on the South Range, Nellis Air Force Base, Nevada*. U.S. Air Force Air Combat Command Series, Report of Investigations Number 13. Geo-Marine, Inc., Las Vegas. Submitted to U.S. Army Corps of Engineers, Fort Worth District, and Nellis Air Force Base, Nevada.
- Duke, D., D. C. Young, and C. Smith
1998 *Placer County Land Transfer: National Register Evaluation of Prehistoric Site 05-17-57-256, Squaw Valley, California*. Heritage Resources Report No. 05-17-1243, Truckee Ranger District, Tahoe National Forest. Copies available from Tahoe National Forest Supervisor's Office, Nevada City.
- Earle, T. K.
1980 A Model of Subsistence Change. In *Modeling Change in Prehistoric Subsistence Economics*, edited by T. K. Earl and A. L. Christenson, pp. 1-26. Academic Press, New York.
- Elston, R. G.
1982 Good Times, Hard Times: Prehistoric Culture Change in the Western Great Basin. In *Man and Environment in the Great Basin*, edited by D. B. Madsen and J. F. O'Connell, pp. 186-206. Society for American Archaeology Papers 2, Washington D.C.

1986 Lithic Technology. In *The Archaeology of the Vista Site, 26-WA-3017*, edited by C. D. Zeier and R. G. Elston, pp. 363-372. Intermountain Research, Silver City. Submitted to the Nevada Department of Transportation, Contract No. P51-84-013. Copies available from the Nevada Department of Transportation, Carson City.

- 1990 A Cost-Benefit Model of Lithic Assemblage Variability. In *The Archaeology of James Creek Shelter*, edited by R. G. Elston and E. E. Budy, pp. 153-163. Anthropological Papers No. 115. University of Utah Press, Salt Lake City.
- 1992 Modeling the Economics and Organization of Lithic Procurement. In *Archaeological Investigations at Tosawihi, A Great Basin Quarry, Part 1: The Periphery*, edited by R. G. Elston and C. Raven, pp. 31-47. Intermountain Research, Silver City. Submitted to the Bureau of Land Management. Copies available from Bureau of Land Management, Elko.
- 1994 Prehistoric Strategies for Living Behind the Argenta Rim. In *Behind the Argenta Rim: Prehistoric Land Use in Whirlwind Valley and the Northern Shoshone Range*, edited by R. G. Elston and M. Bullock, pp. 351-360. Intermountain Research, Silver City. BLM Cultural Resources Report No. 6-1513-1. Submitted to Bureau of Land Management, Battle Mountain Field Office, and Santa Fe Pacific Gold Corporation. Copies available from Bureau of Land Management, Battle Mountain Field Office.
- Elston, R. G., and M. Bullock (editors)
- 1994 *Behind the Argenta Rim: Prehistoric Land Use in Whirlwind Valley and the Northern Shoshone Range*. Intermountain Research, Silver City. BLM Cultural Resources Report No. 6-1513-1. Submitted to Bureau of Land Management, Battle Mountain Field Office, and Santa Fe Pacific Gold Corporation. Copies available from Bureau of Land Management, Battle Mountain Field Office.
- Elston, R. G., and C. Raven (editors)
- 1992 *Archaeological Investigations at Tosiwihi, A Great Basin Quarry*. Intermountain Research, Silver City. Submitted to the Bureau of Land Management. Copies available from Bureau of Land Management, Elko.
- Ericson, J. E., and B. A. Purdy
- 1984 *Prehistoric Quarries and Lithic Productions*. Cambridge University Press, New York.
- Fowler, C. S.
- 1990 Ethnographic Perspectives on Marsh-Based Cultures in Western Nevada. In *Wetland Adaptations in the Great Basin*, edited by J. C. Janetski and David B. Madsen, pp. 17-32. Brigham Young University Museum of Peoples and Cultures No. 1, Provo.
- Fry, G. F., and G. F. Dalley
- 1979 The Levee Site and the Knoll Site. *University of Utah Anthropological Papers* 100, Salt Lake City.
- Gilbert, G. K.
- 1890 Lake Bonneville. *U.S. Geological Survey Monograph 1*, Washington.

- Goodyear, A.
1979 *A Hypothesis for the Use of Cryptocrystalline Raw Materials Among Paleo-Indian Groups of North America*. Research Manuscripts Series No. 156. Institute of Archaeology and Anthropology, University of South Carolina, Columbia.
- Grayson, D. K.
1983 The Paleontology of Gatecliff Shelter: Small Mammals. In *The Archaeology of Monitor Valley: 2. Gatecliff Shelter*, edited by D. H. Thomas, pp. 98-126. American Museum of Natural History Anthropological Papers 59(1).
1993 *The Desert Past: A Natural Prehistory of the Great Basin*. Smithsonian Institution Press, Washington, D.C.
1998 Moisture History and Small Mammal Community Richness during the Latest Pleistocene and Holocene, Northern Bonneville Basin, Utah. *Quaternary Research* 49:330-334.
- Harper, K. T., and G. M. Alder
1972 Paleoclimatic Inferences Concerning the Last 10,000 Years from a Resampling of Danger Cave, Utah. In *Great Basin Cultural Ecology: A Symposium*, edited by D. D. Fowler, pp.13-23. *University of Nevada, Desert Research Institute Publications in the Social Sciences* 8, Reno.
- Hayden, B. H., N. Franco, and J. Spafford
1996 Evaluating Lithic Strategies and Design Criteria. In *Stone Tools: Theoretical Insights into Human Prehistory*, edited by G. H. Odell, pp. 9-49. Plenum Press, New York.
- Heizer, R. F., and A. B. Elsasser
1953 *Some Archaeological Sites and Cultures of the Central Sierra Nevada*. University of California Archaeological Survey Reports No. 21. University of California, Berkeley.
- Janetski, J. C., and D. B. Madsen
1990 *Wetland Adaptations in the Great Basin*. Museum of People and Cultures, Occasional Papers No. 1. Brigham Young University, Provo
- Jennings, J. D.
1957 *Danger Cave*. University of Utah Anthropological Papers No. 27. University of Utah Press, Salt Lake City.
- Jennings, J. D., and D. Sammons-Lohse
1981 Bull Creek. *University of Utah Anthropological Papers* 105, Salt Lake City.
- Jennings, J. D., A. R. Schroedl, and R. N. Holmer
1980 *Sudden Shelter*. University of Utah Anthropological Papers No. 103. University of Utah Press, Salt Lake City.

- Johnson, J. K, and C. A. Morrow (editors)
1987 *The Organization of Core Technology*. Westview Press, Boulder.
- Jones, G. T., D. G. Bailey, and C. Beck
1997 Source Provenance of Andesite Artifacts Using Non-Destructive XRF Analysis. *Journal of Archaeological Science* 24:929-943.
- Jones, G. T., and C. Beck
1999 Paleoarchaic Archaeology in the Great Basin. In *Models for the Millennium: Great Basin Anthropology Today*, edited by C. Beck, pp.83-95. University of Utah Press, Salt Lake City.
- Keene, A. S.
1983 Biology, Behavior and Borrowing: A Critical Examination of Optimal Foraging Theory in Archaeology. In *Archaeological Hammers and Theories*, edited by J. A. Moore and A. S. Keene, pp.137-155. Academic Press, New York.
- Kelly, R. L.
1985 *Hunter-Gatherer Mobility and Sedentism: A Great Basin Study*. Ph.D. dissertation, University of Michigan, Ann Arbor.

1988 The Three Sides of a Biface. *American Antiquity* 53(4):717-734.

1995 *The Foraging Spectrum: Diversity in Hunter-Gatherer Lifeways*. Smithsonian Institution Press, Washington.

2001 *Prehistory of the Carson Desert and Stillwater Mountains: Environment, Mobility, and Subsistence in a Great Basin Wetland*. University of Utah Anthropological Papers No. 123. University of Utah Press, Salt Lake City.
- Kelly, R. L., and L. C. Todd
1988 Coming into the Country: Early Paleoindian Hunting and Mobility. *American Antiquity* 53:231-244.
- Kuhn, S. L.
1994 A Formal Approach to the Design and Assembly of Transported Toolkits. *American Antiquity* 59:426-442.

1995 *Mousterian Lithic Technology: An Ecological Perspective*. Princeton University Press, Princeton.
- Lamb, S.
1958 Linguistic Prehistory of the Great Basin. *International Journal of American Linguistics* 25:95-100.

Livingston, S.

- 2001 Avian Faunal Remains. In *Prehistory of the Carson Desert and Stillwater Mountains: Environment, Mobility, and Subsistence in a Great Basin Wetland*, by R. L. Kelly, pp. 280-288. University of Utah Anthropological Papers No. 123. The University of Utah Press, Salt Lake City.

Madsen, D. B.

- 1975 Three Frémont Sites in Emery County, Utah. *Utah Division of State History, Antiquities Section Selected Papers* 1(1), Salt Lake City.
- 1980 Preliminary Analysis of Prehistoric Occupation Patterns, Subsistence Adaptations, and Chronology in the Fish Springs Area, Utah. Utah State Historical Society, Antiquities Section Special Report.
- 1982a Get it Where the Gettin's Good: A Variable Model of Great Basin Subsistence and Settlement Based on Data from the Eastern Great Basin. In *Man and Environment in the Great Basin*, edited by D. B. Madsen and J. F. O'Connell, pp.207-226. Society for American Archaeology Papers 2, Washington D.C.
- 1982b Prehistoric Occupation Patterns, Subsistence Adaptations, and Chronology in the Fish Springs Area, Utah. In *Archaeological Investigations in Utah*, assembled by D. B. Madsen and R. E. Fike. *Utah Bureau of Land Management, Cultural Resource Series* 12, Salt Lake City.
- 2000 *Late Quaternary Paleoecology in the Bonneville Basin*. Utah Geological Survey Bulletin 130, Salt Lake City.

Madsen, D. B., and M. S. Berry

- 1975 A Reassessment of Northeastern Great Basin Prehistory. *American Antiquity* 40:391-405.

Madsen, D. B., and J. C. Janetski

- 1990 Introduction. In *Wetland Adaptations in the Great Basin*, edited by J. C. Janetski and David B. Madsen, pp. 1-4. Brigham Young University Museum of Peoples and Cultures No. 1, Provo.

Madsen, D. B., and L. W. Lindsay

- 1977 Backhoe Village. *Utah Division of State History, Antiquities Section Selected Papers* 4(12), Salt Lake City.

Madsen, D. B., C. G. Oviatt, D. N. Schmitt and K. Callister

- 2000 *The Paleoarchaic Occupation of the Old River Bed Delta, Utah: Environmental Context and Chronology*. Paper presented at the 27th Great Basin Anthropological Conference, Ogden, Utah.

Madsen, D. B., and D. Rhode (editors)

- 1994 *Across the West: Human Population Movement and the Expansion of the Numa*. University of Utah Press, Salt Lake City.

Madsen, D. B. and S. R. Simms

- 1998 The Fremont Complex: A Behavioral Perspective. *Journal of World Prehistory* 12:255-236.

Malouf, C.

- 1974 The Gosiute Indians. In *Shoshone Indians*, pp. 25-172. Garland Publishing Inc., New York.

Marwitt, J. P.

- 1970 Median Village and Frémont Culture Regional Variation. *University of Utah Anthropological Papers* 95, Salt Lake City.

- 1986 Freemont Cultures. In *Great Basin*, edited by W. L. d'Azevedo, pp. 161-172. Handbook of North American Indians, vol. 11, W. C. Sturtevant, general editor. Smithsonian Institution, Washington, D.C.

Marwitt, J. P., G. F. Fry, and J. M. Adovasio

- 1971 Sandwich Shelter. In Great Basin Anthropological Conference, 1970: Selected Papers. *University of Oregon Anthropological Papers* 1, Eugene.

Mehringer, P. J., Jr.

- 1977 Great Basin Late Quaternary Environments and Chronology. In Models and Great Basin Prehistory: A Symposium, edited by D. D. Fowler. *Desert Research Institute Publications in the Social Sciences* 12:195-210. Desert Research Institute, Reno.

- 1986 Prehistoric Environments. In *Great Basin*, edited by W. L. d'Azevedo, pp. 31-50. Handbook of North American Indians, vol. 11, W. C. Sturtevant, general editor. Smithsonian Institution, Washington, D.C.

Morss, N. M.

- 1954 Clay Figurines of the American Southwest. *Papers of the Peabody Museum of American Archaeology and Ethnology, Harvard University* 49(1), Cambridge.

Nash, S.

- 1996 The Confusion on "Curation": A Framework for Evaluation of Concepts and Terms. In *Stone Tools: Theoretical Insights into Human Prehistory*, edited by G. Odell, pp. 81-99. Plenum Press, New York.

Nelson, M. C.

- 1991 The Study of Technological Organization. In *Advances in Archaeological Method and Theory, Volume 3*, edited by M. Schiffer, pp. 57-100. University of Arizona Press, Tucson.

Nowak, C. L., R. S. Nowak, R. J. Tausch, and P. E. Wigand

- 1994 Tree and Shrub Dynamics in Northwestern Great Basin Woodland and Shrub Steppe During Late-Pleistocene and Holocene. *American Journal of Botany* 81(3):256-277.

- Odell, G. H.
1996a Economizing Behavior and the Concept of "Curation." In *Stone Tools: Theoretical Insights into Human Prehistory*, edited by G. H. Odell, pp. 51-80. Plenum Press, New York.
1996b *Stone Tools: Theoretical Insights into Human Prehistory*. Plenum Press, New York.
- Oviatt, C. G.
1988 Late Pleistocene and Holocene Lake Fluctuations in the Sevier Lake Basin, Utah, USA. *Journal of Paleolimnology* 1:9-21.
1989 *Quaternary Geology of Part of the Sevier Desert, Millard County, Utah*. Utah Geological and Mineral Survey Special Studies 70, Salt Lake City.
1997 Lake Bonneville Fluctuations and Global Climate Change. *Geology* 25:155-158.
- Oviatt, C. G., and D. B. Madsen
2000 *Surficial Deposits and Late Quaternary History of Dugway Proving Ground, Utah: Progress Report 1999*. Utah Geological Survey. Submitted to Dugway Proving Grounds, Environmental Directorate. Copies available from Dugway Proving Grounds, Dugway.
- Oviatt, C. G., D. R. Currey, and D. Sack
1992 Radiocarbon Chronology of Lake Bonneville, Eastern Great Basin, USA. *Palaeogeography, Palaeoclimatology, Palaeoecology* 99:225-241.
- Oviatt, C. G., D. Sack, and T. J. Felger
1994 *Quaternary Geology of the Old River Bed and Vicinity, Millard, Juab, and Tooele Counties, Utah*. Geological Survey Map #M-161.
- Parry, W. J., and R. L. Kelly
1987 Expedient Core Technology and Sedentism. In *The Organization of Core Technology*, edited by J. K. Johnson and C. A. Morrow, pp. 285-304. Westview Press, Boulder.
- Pendleton, L. S.
1979 *Lithic Technology in Early Nevada Assemblages*. Unpublished Master's thesis, Department of Anthropology, California State University, Long Beach.
- Raymond, A. W., and V. M. Parks
1990 Archaeological Sites Exposed by Recent Flooding of Stillwater Marsh Carson Desert, Churchill County, Nevada. In *Wetland Adaptations in the Great Basin*, edited by J. C. Janetski and David B. Madsen, pp. 33-62. Museum of People and Cultures, Occasional Papers No. 1. Brigham Young University, Provo.
- Richards, T. H.
1988 Microwear Patterns on Experimental Basalt Tools. BAR International Series 460, Oxford.

Rogers, M. J.

- 1958 San Dieguito Implements from the Terraces of the Rincon-Pantano and Rillito Drainage System. *The Kiva* 24(1):1-23.

Roney, J.

- 1978 Pine Forest Recreation Area, 1977. Cultural Resources Report No. 2-185, Bureau of Land Management, Winnemucca Field Office, Nevada.

Rusco, M. K., J. O. Davis, and J. R. Firby

- 1979 *Archaeological Investigations Near Treaty Hill, Humboldt County, Nevada: Section 29*. Archaeological Services, Nevada State Museum, Carson City. Submitted to the Westinghouse Corporation, Environmental Services Division. Copies available from Nevada State Museum, Carson City.

Schmitt, D. N., and N. D. Sharp

- 1990 Mammals in the Marsh: Zooarchaeological Analysis of Six Sites in the Stillwater Marsh Area, Nevada. In *Wetland Adaptations in the Great Basin*, edited by J. C. Janetski and David B. Madsen, pp. 75-96. Museum of People and Cultures, Occasional Papers No. 1. Brigham Young University, Provo.

Simms, S. R.

- 1977 A Mid-Archaic Subsistence and Settlement Shift in the Northeastern Great Basin. In *Models and Great Basin Prehistory: A Symposium*, edited by D. D. Fowler. *Desert Research Institute Publications in the Social Sciences* 12:195-210. Desert Research Institute, Reno.
- 1984 *Aboriginal Great Basin Foraging Strategies: An Evolutionary Analysis*. Ph.D. dissertation, Department of Anthropology, University of Utah, Salt Lake City.
- 1987 *Behavioral Ecology and Hunter-Gatherer Foraging: An Example from the Great Basin*. British Archaeological Reports, International Series 381.
- 1988 Conceptualizing the Paleo-Indian and Archaic in the Great Basin. In *Early Human Occupation in the Far Western North America: The Clovis-Archaic Interface*, edited by J. A. Willig, C. M. Aikens, and J. L. Fagan, pp. 41-52. Nevada State Museum Anthropological Papers No. 21. Nevada State Museum, Carson City.

Smith, E. A., and B. Winterhalder (editors)

- 1992 *Evolutionary Ecology and Human Behavior*. Hawthorne, New York.

Smith, E. R.

- 1952 The Archaeology of Deadman Cave, Utah: A Revision. *University of Utah Anthropological Papers* 10, Salt Lake City.

Steward, J. H.

- 1938 *Basin-Plateau Aboriginal Sociopolitical Groups*. Smithsonian Institution Bureau of American Anthropology Bulletin 120. United States Government Printing Office, Washington D.C.

- Thomas, D. H.
1981 How to Classify Projectile Points from Monitor Valley, Nevada. *Journal of California and Great Basin Anthropology* 3(1):7-43.
1983 *The Archaeology of Monitor Valley 2: Gatecliff Shelter*. Anthropological Papers of the American Museum of Natural History 59, Part 1. New York.
- Thomas, D. H., and S. L. Bierwirth
1983 Material Culture of Gatecliff Shelter: Additional Stone Tools. In *The Archaeology of Monitor Valley: 2. Gatecliff Shelter*, edited by D. H. Thomas, pp. 212-245. American Museum of Natural History Anthropological Papers 59(1).
- Thomas, D. H., L. S. Pendleton, and S. C. Cappannari
1986 Western Shoshone. In *Great Basin*, edited by W. L. d'Azevedo, pp. 262-283. Handbook of North American Indians, vol. 11, W. C. Sturtevant, general editor. Smithsonian Institution, Washington, D.C.
- Torrence, R.
1983 Time Budgeting and Hunter-Gatherer Technology. In *Hunter-Gatherer Economy in Prehistory*, edited by G. Bailey, pp. 11-22. Cambridge University Press, Cambridge.
- Torrence, R. (editor)
1989 *Time, Energy, and Stone Tools*. Cambridge University Press, Cambridge.
- Tuohy, D. R.
1986 Portable Art Objects. In *Great Basin*, edited by W. L. d'Azevedo, pp. 227-237. Handbook of North American Indians, vol. 11, W. C. Sturtevant, general editor. Smithsonian Institution, Washington, D.C.
- Warren, C. N.
1967 The San Dieguito Complex: A Review and Hypothesis. *American Antiquity* 32(2):168-185.
- Warren, C. N., and D. L. True
1961 The San Dieguito Complex and Its Place in California Prehistory. Archaeological Survey Annual Report 1960-1961, pp. 246-338. Department of Anthropology and Sociology, University of California, Los Angeles.
- Weder, D. G., and A. Ugan
2000 *WCMD (West TS-5 Area) Target and Access Road*. Report prepared for U.S. Department of Defense, Hill Air Force Base, Utah.
- Willig, J. A.
1989 *Paleo-Archaic Broad Spectrum Adaptations at the Pleistocene-Holocene Boundary in Far Western North America*. Ph.D. dissertation, Department of Anthropology, University of Oregon, Eugene.

Willig, J. A., and C. M. Aikens

- 1988 The Clovis-Archaic Interface in Far Western North America. In *Early Human Occupation in the Far Western North America: The Clovis-Archaic Interface*, edited by J. A. Willig, C. M. Aikens, and J. L. Fagan, pp. 1-40. Nevada State Museum Anthropological Papers No. 21. Nevada State Museum, Carson City.

Winterhalder, B., and E. A. Smith (editors)

- 1981 *Hunter-Gatherer Foraging Strategies: Ethnographic and Archaeological Analyses*. University of Chicago Press, Chicago.

Young, D. C.

- 2002a *Distributary Channel System and the Late Pleistocene/Early Holocene Transition at TS-5, Great Salt Lake Desert, Utah*. Paper presented at the 28th Great Basin Anthropological Conference, Elko.
- 2002b Backhoe Trenching. In *Archaeological Monitoring of Target and Access Road Development for the TS-5-2 Target Area, Utah Test and Training Range, Tooele County, Utah*, by D. G. Duke, pp. 14-19. U.S. Air Force Air Combat Command Series, Reports of Investigations Number 12. Geo-Marine, Inc., Las Vegas.

APPENDIX A
DEBITAGE RECORDING FORMS

FLAKE TALLY SHEET (Basalt) Site _____ Feature _____ Recorders _____ Date _____
 Sampling Unit/Locus/Shovel Probe _____ Size _____ Visibility % _____ page _____ of _____
Instructions: process flake through key and place tick marks in boxes; place cortical flakes above faded line, non-cortical below

CLASSIFICATION KEY:

<1/8 1/8-1/4 1/4-1/2 1/2-1 1-2 >2 **TOTALS**

1. Can exterior and interior surfaces be identified?

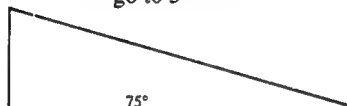
No.... **SHATTER**
 Yes....go to 2

SHT

2. Is a striking platform present?

No.... **INDETERMINATE**
 Yes....go to 3

IND



3. Is there a platform angle of less than 75 degrees?

No.... **CORE REDUCTION**
 Yes.... go to 4

CR

4. Is the flake less than 1/4" in size along any dimension?

No.... **4a. Is the flake complete?**

No.... **BIFACE REDUCTION**
 Yes.... go to 4b

BR

4b. Are there more than 3 exterior flake scars?

No.... **EARLY BIFACE REDUCTION**

EBR

Yes....**LATE BIFACE REDUCTION**

LBR

Yes.... go to 5

5. Is the flake elongate with a small, ground platform?

Yes.... **PRESSURE**

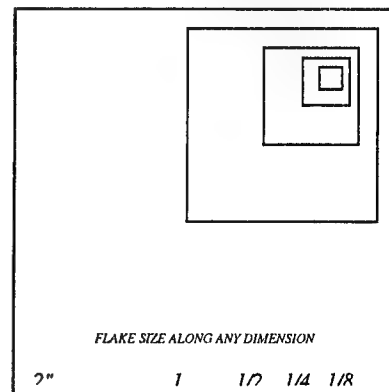
PR

No.... **RETOUCH/EDGE PREPARATION**

REP

TOTALS

Comments _____



FLAKE TALLY SHEET (CCS/Obsidian) Site _____ Feature _____ Recorders _____ Date _____

Sampling Unit/Locus/Shovel Probe _____ Size _____ Visibility % _____ page _____ of _____

Instructions: process flake through key and place tick marks in boxes;
place cortical flakes above faded line, non-cortical below

Material Type: _____

CLASSIFICATION KEY:

<1/8 1/8-1/4 1/4-1/2 1/2-1 1-2 >2 TOTALS

1. Can exterior and interior surfaces be identified?

No.... **SHATTER**

SHT

Yes....go to 2

2. Is a striking platform present?

No.... ↘ 2a. Does the flake exhibit both longitudinal curvature and low arrises?

Yes.... **BIFACE REDUCTION (DISTAL)**

DBR

No.... go to 2b

↘ 2b. **INDETERMINATE**

IND

Yes....go to 3

3. Is the striking platform planar?

Yes.... ↘ 3a. Is the flake complete?

No.... **CORE REDUCTION**

CR

Yes.... go to 3b

↘ 3b. Are there more than 3 exterior flake scars?

No.... **EARLY CORE REDUCTION**

ECR

Yes.... **LATE CORE REDUCTION**

LCR

No.... go to 4

4. Is the flake less than 1/4" in size along any dimension?

No.... ↘ 4a. Is the flake complete?

No.... **BIFACE REDUCTION**

BR

Yes.... go to 4b

↘ 4b. Are there more than 3 exterior flake scars?

No.... **EARLY BIFACE REDUCTION**

EBR

Yes.... **LATE BIFACE REDUCTION**

LBR

Yes.... go to 5

5. Is the flake elongate with a small, ground platform?

Yes.... **PRESSURE**

PR

No.... **RETOUCH/EDGE PREPARATION**

REP

TOTALS

Comments _____

FLAKE SIZE ALONG ANY DIMENSION

2" 1 1/2 1/4 1/8

APPENDIX B
ARTIFACT CATALOG

Key to Artifact Catalog

Measurements

Weight: grams

Length: millimeters

Width: millimeters

Thickness: millimeters

Attributes

Blank Evidence: PC=plano-convex, BS=blank scar, LC=longitudinal curve
(flake type is noted if identifiable)

Breakage: LS=lateral snap, P=perverse fracture, I=impact, N=none

South Route Artifact Catalog

Catalog #	Material	Weight	Length	Width	Thickness	Blank Evidence	Breakage	Rejuvenation	Cortex	Type
0.13.0	obsidian	9.3	37	34	7		I		<input type="checkbox"/>	rough pressure
0.14.0	basalt	54.7	67	43	14	early core red.	LS		<input type="checkbox"/>	roughout
0.16.0	obsidian	13.6	46	34	8		N		<input type="checkbox"/>	rough pressure
0.19.0	basalt	18.9	72	35	6	indeterminate	N		<input type="checkbox"/>	roughout
0.2.0	obsidian	8.1	53	23	7		N		<input type="checkbox"/>	Western Stemmed
0.20.0	basalt	5.3	39	21	6	indeterminate	N		<input type="checkbox"/>	Western Stemmed
0.23.0	basalt	27.6	77	32	12	early core red.	n/a		<input type="checkbox"/>	formed flake tool
0.24.0	basalt	12.2	52	31	6	biface red.	n/a		<input type="checkbox"/>	roughout
0.26.0	obsidian	14.3	51	32	11	PC	N		<input type="checkbox"/>	rough percussion
0.27.0	basalt	25.1	62	28	13		n/a		<input type="checkbox"/>	edge damaged flake
0.28.0	obsidian	7.4	44	24	8	PC	N		<input type="checkbox"/>	Western Stemmed
0.30.0	basalt	5.7	36	29	6	PC	N		<input type="checkbox"/>	Western Stemmed
0.31.0	obsidian	3	26	18	6	PC	LS		<input type="checkbox"/>	Western Stemmed
0.34.0	basalt						n/a		<input type="checkbox"/>	indeterminate flake
0.36.1	basalt						n/a		<input type="checkbox"/>	core reduction flake
0.36.2	basalt	3.3	26	19	6	PC	LS		<input type="checkbox"/>	rough percussion
0.4.0	obsidian	6.8	41	25	6	PC	LS		<input type="checkbox"/>	Western Stemmed

B-4

Catalog #	Material	Weight	Length	Width	Thickness	Blank Evidence	Breakage	Rejuvenation	Cortex	Type
0.8.0	basalt	9.1	27	36	8		LS		<input type="checkbox"/>	rough percussion
0.9.1	basalt						n/a		<input type="checkbox"/>	core reduction flake
0.9.2	basalt	37.1	67	38	14	early core red.	n/a		<input type="checkbox"/>	edge damaged flake
1.1.0	basalt	29	55	42	10	PC, BS	LS		<input type="checkbox"/>	roughout
1.10.0	basalt	28.8	71	36	11	indeterminate	n/a		<input type="checkbox"/>	edge damaged flake
1.2.0	obsidian	3.6	26	18	7		LS	beveled	<input type="checkbox"/>	Western Stemmed
1.3.0	basalt	11.7	36	34	8	indeterminate	n/a		<input checked="" type="checkbox"/>	edge damaged flake
1.4.0	basalt	13.7	63	29	6	indeterminate	n/a		<input type="checkbox"/>	edge damaged flake
1.5.0	basalt	11.8	64	20	7	early core red.	n/a		<input checked="" type="checkbox"/>	formed flake tool
1.6.0	basalt	2.6	18	23	5	indeterminate	LS		<input type="checkbox"/>	formed flake tool
1.7.0	basalt	3.5	18	31	7	indeterminate	LS		<input type="checkbox"/>	formed flake tool
1.8.0	basalt						n/a		<input type="checkbox"/>	biface reduction flake
1.9.0	obsidian						n/a		<input checked="" type="checkbox"/>	shatter
0.37.0	obsidian	15.2	71	25	8		N	beveled	<input type="checkbox"/>	Western Stemmed
0.38.0	basalt	18.9	75	32	7		LS		<input type="checkbox"/>	fine percussion
0.39.0	basalt	36.1	99	30	9		LS		<input type="checkbox"/>	Haskett
2.1.0	basalt	21.3	50	37	9	PC	LS		<input type="checkbox"/>	rough percussion
2.2.0	basalt	15.9	65	30	9		N		<input type="checkbox"/>	rough percussion
2.3.0	basalt	25.1	56	29	12	BS	N		<input checked="" type="checkbox"/>	roughout

Catalog #	Material	Weight	Length	Width	Thickness	Blank Evidence	Breakage	Rejuvenation	Cortex	Type
2.4.0	basalt	20.9	54	29	13	BS	N		<input type="checkbox"/>	roughout
2.5.0	basalt	5.1	19	31	7		LS		<input type="checkbox"/>	rough percussion
2.6.0	obsidian	2.9	26	18	5	BS, PC, LC	N		<input type="checkbox"/>	Western Stemmed
2.7.0	basalt	4	22	21	9	BS, PC	LS		<input type="checkbox"/>	Western Stemmed
2.8.0	basalt	6	31	25	9		N		<input type="checkbox"/>	Western Stemmed
2.9.0	obsidian	3.3	30	13	6		n/a	beveled	<input type="checkbox"/>	Western Stemmed
3.1.0	basalt	7.4	24	36	7		LS		<input type="checkbox"/>	rough percussion
3.2.0	basalt	8.8	57	18	8	PC	N		<input type="checkbox"/>	fine percussion
4.1.0	obsidian	1.8	19	15	6		LS		<input type="checkbox"/>	rough pressure
5.1.0	vesicular basalt	120.8	61	52	30		n/a		<input checked="" type="checkbox"/>	handstone
5.2.0	basalt	14.6	49	34	8		LS		<input type="checkbox"/>	rough percussion
5.3.0	basalt	16.5	59	33	9		LS		<input type="checkbox"/>	rough percussion
5.4.0	basalt	37.8	87	40	11	PC	P		<input type="checkbox"/>	rough percussion
5.5.0	basalt	72	78	69	13	early biface red.	n/a		<input checked="" type="checkbox"/>	edge damaged flake
5.6.0	obsidian	14.2	68	23	8		N	beveled	<input type="checkbox"/>	Western Stemmed
5.7.0	basalt	22	36	50	14		LS		<input type="checkbox"/>	rough percussion
5.8.0	basalt	48	85	45	11	PC	N		<input type="checkbox"/>	rough percussion
6.1.0	basalt	0	155	123	36		n/a		<input checked="" type="checkbox"/>	portable grinding slab
6.2.0	basalt	14	5	33	6	BS	LS		<input type="checkbox"/>	fine percussion

Catalog #	Material	Weight	Length	Width	Thickness	Blank Evidence	Breakage	Rejuvenation	Cortex	Type
6.3.0	CCS	37.5	68	66	9	early core red.	n/a		<input checked="" type="checkbox"/>	formed flake tool
7.1.0	obsidian	3.3	26	18	6		n/a		<input type="checkbox"/>	roughout
7.2.0	obsidian	3.5	15	26	10		LS		<input type="checkbox"/>	rough percussion
7.3.0	basalt	21	34	39	16	PC	I		<input type="checkbox"/>	roughout
7.4.0	obsidian	2.6	27	15	6	PC, LC	n/a		<input type="checkbox"/>	rough pressure
7.5.0	basalt	4.8	29	14	8		LS		<input type="checkbox"/>	rough percussion
7.6.0	basalt	12	34	31	10	PC, BS	LS		<input type="checkbox"/>	rough percussion
8.1.0	basalt	6.7	27	26	8	PC, BS	LS		<input type="checkbox"/>	rough percussion
8.2.0	basalt	18.8	44	39	12		LS		<input type="checkbox"/>	rough percussion
8.3.0	obsidian	3.2	25	18	6	LC, PC, BS	LS		<input type="checkbox"/>	Western Stemmed
8.4.0	basalt	7	39	22	8	BS	N		<input type="checkbox"/>	rough percussion
8.5.0	basalt	14.8	36	35	9		LS		<input type="checkbox"/>	rough percussion
9.1.0	basalt						n/a		<input type="checkbox"/>	core reduction flake
9.2.0	obsidian	2	19	14	6		LS		<input type="checkbox"/>	rough pressure

CONTRACT DATA

This study was prepared for
Hill Air Force Base, Utah Test and Training Range, Tooele County, Utah

FINAL

by
Daron G. Duke

U.S. AIR FORCE AIR COMBAT COMMAND SERIES
REPORTS OF INVESTIGATIONS
NUMBER 17

Geo-Marine, Inc.
2255-A Renaissance Drive
Las Vegas, Nevada 89119

for
U.S. Air Force Air Combat Command
Hill Air Force Base
and
388th Range Squadron

under
U.S. Army Corps of Engineers, Fort Worth District
Contract No. DACA63-99-D-0010, Delivery Order No. 0024
(GMI Project No. 1010-D24)

Utah Division of State History Report No. U-01-GM-0708m

June 2003

United States Air Force
Air Combat Command